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An American Unaflow Engine Installation

DETAILS AND TEST RESULTS FROM AMERICAN FORK & HOE COMPANY'S PLANT, NORTH GIRARD, PA.

RAPID DEVELOPMENT OF THE Unaflow steam engine in Europe, where for the generation of electric power it is largely used, is well known to most engineers; consequently, a description of one of the first plants to install an American Unaflow engine, modified to suit American conditions, should be of more than passing interest.

As built in Europe, the Unaflow engine would have but limited sale in the United States, for the reason that it is designed to operate condensing, European power plants almost without exception, even in small sizes, being located with respect to the accessibility of large bodies of water, and operating condensing.

In the United States, however, fully 90 per cent of the engines built in moderate sizes operate noncondensing, and, as will be shown, the European Unaflow could not be operated economically noncondensing, without a modification of the design such as here described.

As will be seen from Fig. 1, showing a typical European Unaflow cylinder, compression begins as soon as the piston covers the central exhaust ports on its return stroke. The engine may be operated with small clearances for the reason that, while the compression takes place during 90 per cent of the stroke, the vacuum during exhaust prevents the compression from mounting above the initial pressure.

It will be seen, however, that if the engine should be operated noncondensing the compression, starting almost at the beginning of the return stroke, and with atmospheric pressure instead of vacuum in the cylinder, would become excessive and, in fact, would be detrimental to the engine unless large clearances were employed. A Unaflow engine operating noncondensing, with a steam pressure of 125 lb., and a back pressure for heating equivalent to 2 lb., would require a clearance of about 18 per cent.

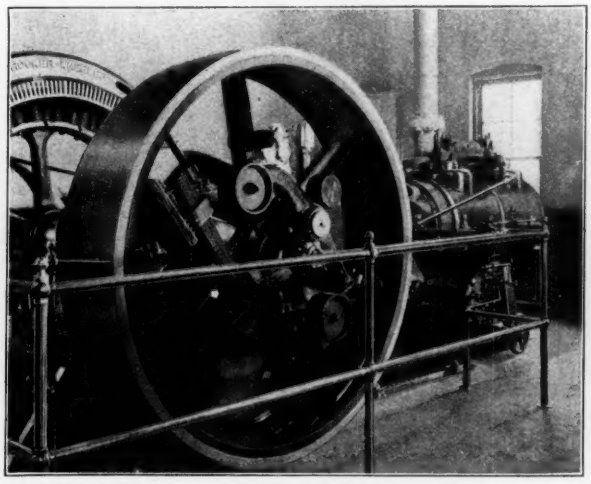


FIG. 2. UNIVERSAL UNAFLOW AS INSTALLED AT NORTH GIRARD PLANT

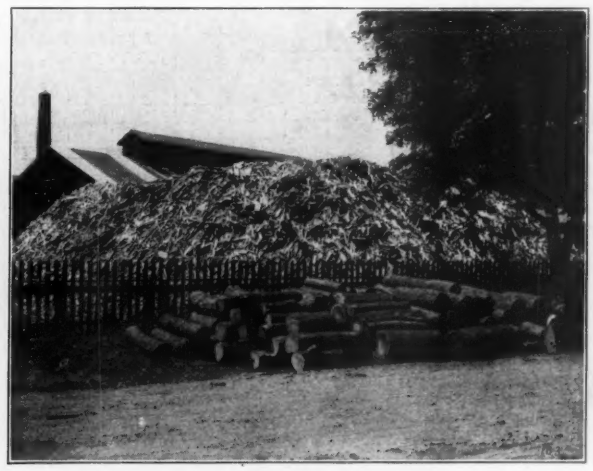


FIG. 3. WOODPILE WHICH THE PLANT DOESN'T NOW USE

Auxiliary Exhaust for Low Compression

Several years ago, L. G. Skinner, president of the Skinner Engine Co., began a series of experiments in which he endeavored to preserve the Unaflow effect when operating noncondensing and employing small clearances; and he devised the simple expedient of delaying the starting of compression by placing auxiliary exhaust valves at that point in a Unaflow cylinder, where it is usual to start compression in a noncondensing counterflow engine.

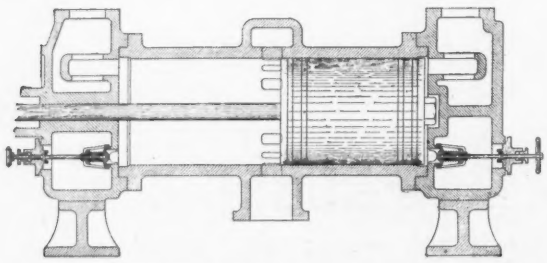


FIG. 1. TYPICAL EUROPEAN UNAFLOW CYLINDER

The object of the Unaflow design is the elimination as nearly as possible, of cylinder condensation; and, to accomplish this, the ends of the cylinder are kept hot, and the center or exhaust belt is kept cool. The expanded steam does not return on its path at the end of the stroke to be exhausted at the end of the cylinder at which it entered, as in the counterflow type, thereby washing the hot cylinder walls and head with this cool expanded steam during 50 to 75 per cent of the return stroke; but it is exhausted at the center of the cylinder, after the piston has uncovered the central exhaust ports.

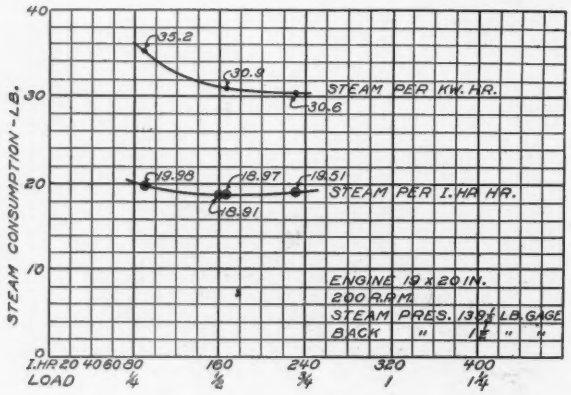


FIG. 4. STEAM CONSUMPTION OF 320-HP. ENGINE

By the adoption of these auxiliary exhaust valves to delay compression, the effect of the Unaflow principle was not destroyed, as the volume of expanded steam ready for exhaust was still emptied from the cylinder through the central exhaust ports, and only the vapor at atmospheric pressure remaining in the cylinder between the central and the auxiliary exhaust ports was removed through the latter ports. These auxiliary exhaust valves were not placed in the ends of the cylinder, as this would cause the trapped steam to sweep the entire length of the cylinder and cool the hot ends with its washing effect.

That the Unaflow principle is still preserved in this arrangement, and that cylinder condensation is largely eliminated, is proven by the fact that the Universal Unaflow engine has practically the same steam consumption per i.hp.-hr. at ¼ load as at full load. This makes it extremely valuable for fluctuating load service, and accounts largely for the saving that this engine is effecting in the North Girard, Pa., works of the American Fork & Hoe Co., as compared with the counterflow engine which it replaced.

The North Girard Plant

The entire plant was installed by the Skinner Engine Co., in accordance with designs furnished by A. B. Roberts, of the Burchard-Roberts-Wales Co., of Cleveland, Ohio, consulting engineers for the purchasers.

This Unaflow engine was a 19 by 20-in., operating at 200 r.p.m., with 135 lb. steam pressure, noncondensing. The contract called for superheaters to be installed; but it was decided that, on account of the fact that the cylinder condensation was to a large extent eliminated

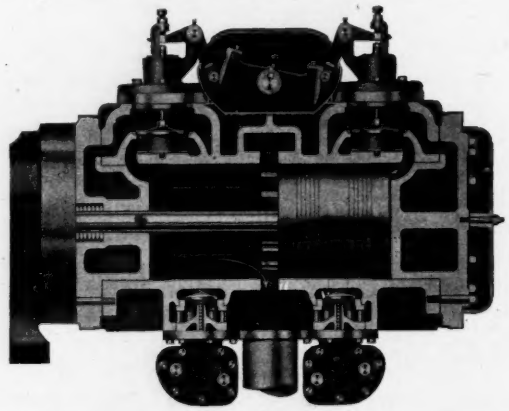


FIG. 5. POSITION A. HEAD END DEAD CENTER; ADMISSION AT HEAD END; EXHAUST THROUGH CENTRAL PORTS ON FRAME END

in this engine, the gain due to superheat would be negligible, and superheaters were, therefore, not furnished.

This engine is direct-connected to a Crocker-Wheeler 250-kv.a., 60-cycle, 3-phase, engine type alternating-current generator, with belted exciter. The boiler plant consists of 2 150-hp. return-tubular boilers, built for 150 lb. working pressure, furnished by the Union Iron Works, of Erie, Pa., served by a radial brick stack, 110 ft. by 54 in., furnished by H. R. Heinicke, Inc. Piping, boiler feed pump and other auxiliaries were furnished and installed by the Skinner Engine Co.

An exhauster brings the sawdust and shavings from the wood shop, located about 600 ft. from the power house, delivering into the boilers.

The handle department, where large ash logs are sawed, imposes a widely fluctuating load on the engine, varying instantaneously from 200 to 420 hp.; but, notwithstanding this violent fluctuation, there is no perceptible variation in voltage, and the lights are steady.

Before the Unaflow engine was installed, the plant required for fuel all the surplus wood from the handle department, including edgings and slabs, as well as sawdust and shavings, and, in addition, an average of 5 tons

of coal a day. At present, it is operating with the Universal Unaflow engine, without burning the refuse wood from the handle department, and consumes only the sawdust and shavings together with from 1½ to 2 tons of coal a day. Therefore, the new engine is saving from 3

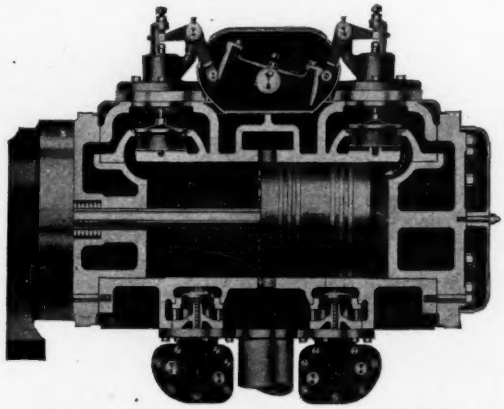


FIG. 6. POSITION B. HEAD END STEAM VALVE FULL OPEN; FRAME END CENTRAL EXHAUST PORTS CLOSING

to 3½ tons of coal a day, in addition to all the refuse wood. Enough refuse wood is sold every day to pay the coal bill for 4 days; and, notwithstanding this fact, the huge pile shown in Fig. 3 has been accumulated.

This noncondensing plant is showing a lower cost of operation than another plant owned by the same company, equipped with compound multivalve engines,

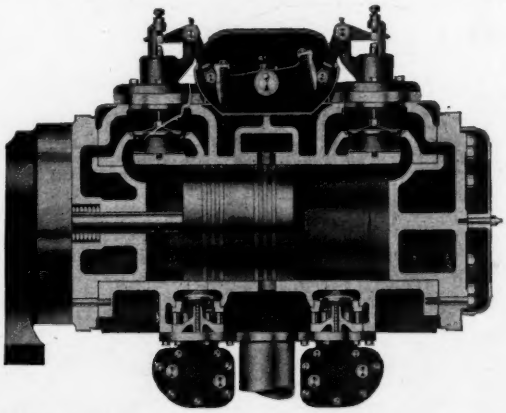


FIG. 8. POSITION D AND D¹. EXPANSION CONTINUING IN HEAD END; COMPRESSION COMMENCES IN FRAME END AS PISTON COVERS AUXILIARY EXHAUST PORT

operating condensing. The Unaflow engine is its sole dependence for power, and has been operating for nearly a year on a night-and-day schedule. On a test conducted by the owners, on the night run, the following interesting results were obtained:

Some Test Results

The test was conducted for 12 hr., during which time coal only was burned. While only one boiler furnished steam for the engine, fire was kept under the second boiler to have it ready for the day load.

Five hundred kilowatt-hours were generated during the 12-hr. test, and 1800 lb. of coal consumed, a coal consumption of only 3.6 lb. per kw.-hr., with an average load of 42 kw. per hour, or approximately 1-5 load.

The owners have found it possible to operate the plant on the day load when furnishing steam from only one of the 150-hp. boilers, and during a recent test run under these conditions, an average of 162 kw. was generated, without hard firing of the boiler.

High economy of the Unaflow engine at light loads is graphically shown in the steam consumption curve,

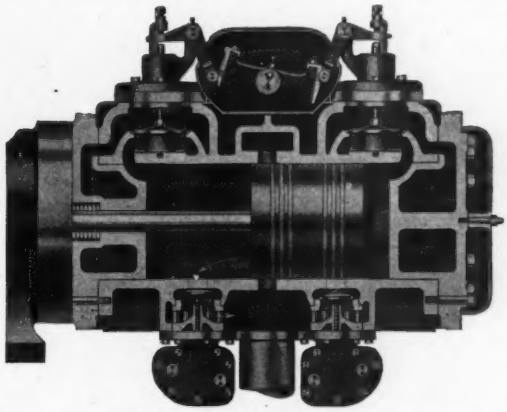


FIG. 7. POSITION C. HEAD END ADMISSION VALVE CLOSING AND EXPANSION COMMENCING; TRAPPED VAPOR EXHAUSTING THROUGH OPEN AUXILIARY EXHAUST VALVE

Fig. 4, which was plotted from a test made by the purchasers' engineer on a duplicate of the engine furnished the American Fork & Hoe Co.

During this test, saturated steam of 139.5 lb. pressure was used, and 1½ lb. back pressure was kept on the exhaust line, the object being to determine the steam consumption of the engine under normal operating conditions. The light load economy is remarkable, as well as the low steam consumption per kilowatt-hour, which

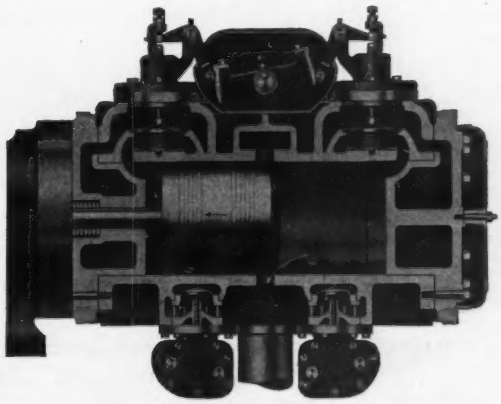


FIG. 9. POSITION E. HEAD END BEGINS EXHAUST THROUGH CENTRAL PORTS; FRAME END CONTINUES COMPRESSION

is partly accounted for by the fact that the engine has a remarkably high mechanical efficiency. During a recent trial, a 21 by 22-in. Universal Unaflow engine, rated at 400 hp., produced a friction card showing only 9.06 i.hp., showing a mechanical efficiency of 97.735 per cent.

This engine operates condensing, as well as noncondensing, and automatically changes its functions with the change in the exhaust conditions; and under both conditions of operation the builders claim that it will give better economy than any compound multivalve engine. It is this feature of automatically accommodating itself to both condensing and noncondensing conditions which led them to name it the Universal Unaflow.

Steam Distribution

Action of the engine, operating noncondensing, is graphically shown in Figs. 5 to 9, while the letters on the accompanying indicator diagram, Fig. 10, correspond to

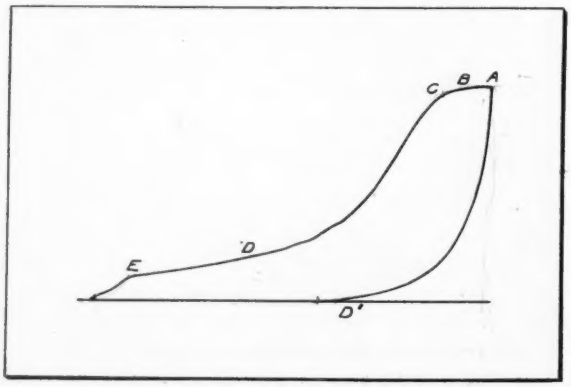


FIG. 10. INDICATOR DIAGRAM SHOWING POSITIONS CORRESPONDING TO FIGS. 5-9

the letters of the cuts and indicate the position of the head end of the piston in each one of these illustrations.

Inasmuch as the principle of the engine is involved in the function of these auxiliary exhaust valves, each operation will be explained in detail: In Fig. 5, the piston is at head end dead center and admission is taking place at that end, while at the frame end, exhaust through central exhaust ports is being accomplished, the auxiliary exhaust valve being still closed. In Fig. 6, the head end poppet admission valve is full open, while at the frame end, central exhaust ports are about to be

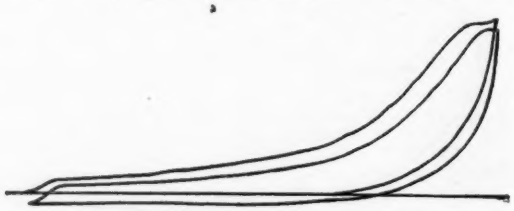


FIG. 12. DIAGRAMS SHOWING CHANGE FROM CONDENSING TO NONCONDENSING ACTION

closed by the piston. It is important to note that at this point the auxiliary exhaust valve at the frame end is about to open, this opening being accomplished when the steam has exhausted from the cylinder, and when there is exhaust pressure on both sides of the valve, so that the valve opens, under no difference in pressure.

Figure 7 shows the head end admission valve closing, and the beginning of expansion. At the frame end the auxiliary exhaust valve is wide open, and the trapped vapor between the approaching piston and the auxiliary exhaust port is allowed to escape through this port. In Fig. 8, head end expansion is continuing and in the frame end, the piston has crossed the auxiliary exhaust port so that compression has commenced. Compression, instead of starting as soon as the piston has crossed the central exhaust port, has been delayed, which allows the engine to operate noncondensing with small clearances. As further reference will be made to it, the fact should be noted, that the auxiliary exhaust valve is still open, but compression has nevertheless begun, because the piston itself now controls this port. The auxiliary exhaust valve does not close until the piston has nearly reached the end of its stroke; hence, the valve closes with

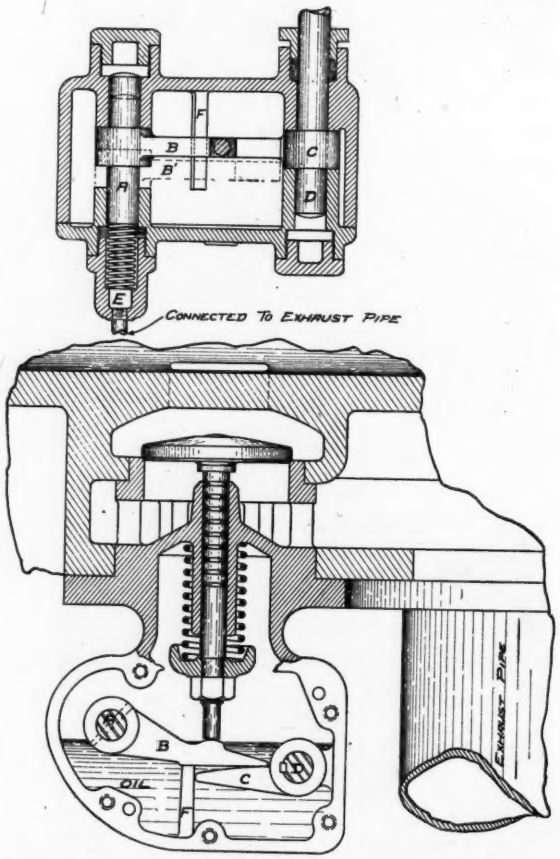


FIG. 11. SECTIONS OF THE POPPET AUXILIARY EXHAUST VALVE AND DRIVING MECHANISM

exhaust pressure on both sides of it, in other words, under no difference in pressure. The position of the frame end of the piston is here indicated at D^1 on the indicator diagram.

Figure 9 shows the beginning of exhaust at the head through central exhaust ports, and continuation of compression in the frame end. Note that the frame end auxiliary exhaust valve is now about to close. It will remain closed during the entire expansion stroke, and will open only when all of the expanded steam has been exhausted through the central exhaust ports.

Auxiliary Exhaust Action and Details

In the above description of the operation of the auxiliary exhaust valves, it has been pointed out that these valves open and close under no difference in pressure on either side of the valve, which, in itself, is an original feature in steam engine design, and possesses some distinct advantages. The easy conditions of operation of these valves permit the employment of a single-seat poppet valve requiring much less clearance than the double-seat valve which would have been necessary if the valves were to open and close against pressure. It also allows the adoption of simple and compact driving gear, Fig. 11, upon which there are no strains, and a spring of but small tension is required. These valves have been operated without any spring whatever.

Clearance in the auxiliary ports is less than one per cent in most of the Unaflow engines which the Skinner Engine Co. is building. It will be noted that the spring

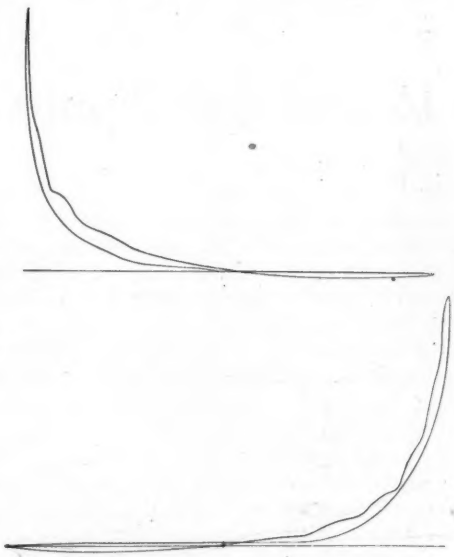


FIG. 13. FRICTION DIAGRAMS FROM 13 BY 16 UNIVERSAL UNAFLOW ENGINE

telescopes around the valve stem guide so that the entire exhaust gear may be above the floor, and therefore accessible.

When operating condensing, the auxiliary exhaust valves are automatically disengaged, and remain closed at all times unless the vacuum should break, whereupon the valves are automatically placed in operation, and the engine consequently becomes noncondensing again.

In Fig. 11, A is the shaft supporting the idler B, which is operated by shear cam, C, this cam being, in turn, operated by the engine valve gear, which is connected to shaft, D, on the outside of the cam box.

When cam C raises idler B, the latter raises the single-beat exhaust valve, the stem of which projects within a short distance of B. The spring around the valve stem has only enough tension to insure quick closing when operating at high speeds. The shear cam is so designed that there is practically no sliding action on the idler. Both cam and idler are of steel, and are immersed in oil.

Pocket E is connected to the central exhaust port by means of a small pipe; and the function of the spring in this pocket is to keep the idler, through its attached shaft, in register with the stem of the valve and the cam C directly underneath it. When the vacuum reaches a predetermined point it overcomes the tension of the spring in pocket E, and draws the shaft into the pocket, which shifts the idler to position B^1, and out of register with cam C, so that while that cam still operates, it cannot lift the valve. The valve, therefore, remains closed at all times when vacuum exists in the exhaust pipe, and is held down tightly by the force of the vacuum itself exerted on the under side of the valve. Pressure in the cylinder acting on top of the valve also tends to keep it closed.

Bridge F acts as a slide and a rest for the idler, and holds it at the proper height so that if the vacuum should fail, the spring, exerting itself in pocket E, would slide the idler between the cam and valve stem, whereupon the auxiliary exhaust valve begins its functions, and the engine automatically returns to noncondensing action. These auxiliary exhaust valves are provided with laby-

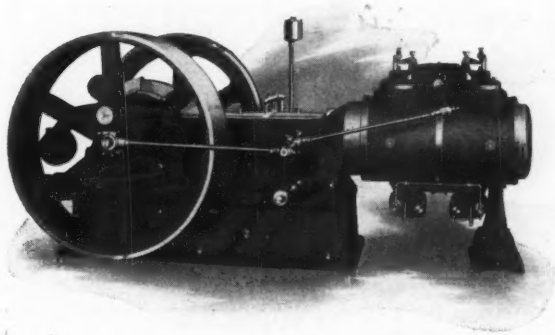


FIG. 14. ENGINE FROM WHICH DIAGRAMS OF FIG. 13 WERE TAKEN

rinth or water-groove packing, which has been found to be practically frictionless and to remain steam-tight for years.

The indicator diagram, reproduced in Fig. 12, was taken from a Universal Unaflow, operating both condensing and noncondensing, the cards being taken about 10 sec. apart,—the time required to break the vacuum. Operating condensing, it will be noted that the compression begins at 10 per cent of the return stroke, because the auxiliary exhaust valves are not in operation; and, when operating noncondensing, the compression has been delayed by the means just described.

Admission Gear

Admission valve gear is extremely simple, as seen in Figs. 5-9, consisting of one rocker shaft, with casehardened steel cams operating in an oil bath, and controlling the operation of the valves by means of forked levers on which are mounted rollers bearing against the cams. Double-beat poppet valves, of a design patented by the Skinner Engine Co., are employed, and, according to the builders, will maintain steam-tightness with steam of high pressure and superheated, or of low pressure and saturated. Instead of mounting the spring above

the valve, as is customary, it is telescoped in the housing, but of course not in the steam space. All adjustments of the valve, cams and rollers are made by one set screw located above the lifters.

It was the builders' intention to design a poppet-valve gear which could be operated successfully at standard generator speeds; and, with this point in mind, the first engine was operated for nearly a year in the builders' shops at a speed of 275 r.p.m. It was then placed in service, and has now been in operation nearly 2 yr. on a night-and-day schedule, at a speed of 257 r.p.m. The owners report that there have been absolutely no repairs or renewals, and that no shut-downs have been necessitated on account of any fault of the engine.

Figure 13 shows friction cards taken from a 160-hp. engine, illustrated in Fig. 14, a 13 by 16-in., which had a friction loss of only 4.49 per cent. This engine, when tested by the owners' engineer, showed the remarkable steam consumption of 16.78 lb. per i.hp.-hr. at 1¼ load, and 17.3 lb. at ¼ load, giving practically a flat curve throughout the entire load range. The steam pressure during this test was 159 lb., with 93 deg. F. superheat, the engine being operated noncondensing. The same engine, when tested under saturated steam conditions, with a steam pressure of 126 lb., showed a steam consumption below 20 lb. per i.hp.-hr. at ½ load.

All of these tests were made without any special preparation of the engine, one test having been made within 7 hr. after the steam and exhaust pipes had been connected to the engine on the builders' test block.

The Skinner Engine Co. states that there are several thousand horsepower of these engines now in active service, a few of them being operated in night-and-day service. The company also points to the fact that superheat and high steam pressure are not as essential for high economy with an engine of this construction as with one employing large clearances or with an engine of the counterflow type. The usual Skinner construction of governor, automatic oiling system and general design of bed and parts is continued in these Unaflow engines, which are built in sizes ranging from 150 to 750 hp.

Governing Engines to Drive Centrifugal Pumps

DANGER OF EXCESSIVE LOAD FROM SLIGHT SPEED INCREASE. BY STERLING H. BUNNELL

WITH the improvement in efficiency of centrifugal pumps, some attention has been given to the economy of the engines driving them. Many centrifugal pumps of large size are now in operation, pumping water for irrigation purposes, draining low lands, lifting sewage, and for other purposes where large quantities must be pumped under low heads, and multi-stage pumps have been developed for higher lifts. As the efficiency of these pumps reaches well above the 50 per cent which was formerly the maximum, the efficient pumps should be connected to efficient engines in order to secure best results from the combined units.

Speeds common for centrifugal pumps of medium size adapt them for direct connection to high-speed engines, which are usually fitted with automatic shaft governors, and are intended primarily for maintaining an exact speed under varying load. Exactness in speed is so essential for the great majority of purposes for which these engines are used, that engineers rarely give thought to the fact that the maintenance of exact speed with centrifugal pumps direct-connected to engines may be the cause of a serious disaster. In several cases, engines of massive design, amply strong for the maximum horsepower and severest overload conditions which would ever be imposed by direct-connected electric generators, have gone to pieces under supposedly light pumping service. Cracked frames, broken crank shafts and other serious breakdowns have resulted, and the damage and loss due to the time lost for repairs often far exceeds the cost of repair, the breakdown being due to the action of the governor, which, endeavoring to perform its duty, has wrecked the engine.

RELATION OF PUMP SPEED TO OUTPUT

WHEN direct-connected to a centrifugal pump, a steam engine is subject to a peculiar load. If the engine is started and allowed to gain speed slowly, the horsepower developed is trifling at first. When the speed reaches that necessary to lift water to the discharge opening, the work of the pump is still extremely small. When, however, water commences to flow from the discharge, the work rapidly increases. At this point an increase in speed of only 2 or 3 turns a minute may double the load on the engine, and there is almost no limit to the load which can be imposed by operating a centrifugal pump faster than the proper speed for the head pumped against, as after the water commences to flow, a small increase in speed causes a large increase in quantity of water pumped, and the horsepower goes up in direct proportion to the quantity.

When a steam engine driving a centrifugal pump is controlled by a shaft governor, the governor must be provided with some means of varying the speed to suit the pumping conditions from time to time, by changing the tension of the springs in the governor, or by changing the amount of weight in the governor arms, such changes being, ordinarily, made only by shutting down the engine. There is no way of deciding the exact speed corresponding to the adjustment of the governor, hence, after an adjustment, the engine is put into service without any knowledge as to whether the governor will regulate to pump the desired quantity of water, or whether it will drive the engine at a speed somewhat in excess of the one desired, and, therefore, pump 2 or 3 times as much water.

GOVERNOR ACTION AS LEVEL CHANGES

WITHIN range of possibilities, it is evident, therefore, that an engine driving a centrifugal pump and controlled by a shaft governor, may easily overrun the speed proper to the head and develop continuously a horsepower 50 to 100 per cent in excess of its proper load. If the speed is correct at first, a change in level of water

in suction well, or discharge reservoir, may affect the head. If the head is thus decreased, the amount of water pumped at the given speed will increase and the governor will dig into the load to its limit and drive the engine at the set speed without regard to its load carrying capacity. Such a change in pump load, occurring without the knowledge of the engineer, may cause an engine to develop cracks in frame or crank shaft, or go to pieces under load, possibly at a time when no overload exists.

Proper Governing

For operating a direct-connected centrifugal pump, the proper governing device is a throttling governor provided with a variable-speed driving gear. To obtain the best economy, the engine should also be provided with a hand-adjusting cutoff, which is easily arranged, even with the common single-valve high-speed engine, through a simple slotted rocker arm, link motion, or other well-known arrangement. In operating such an engine, the cutoff is set approximately at the right point, and the exact maintenance of speed is obtained by the action of the throttling governor. The engine, however, operates with cutoff, and the governor affects the initial steam pressure to the slight extent necessary to suit the power to the load. If the head on the pump decreases, the throttling governor will admit full steam pressure to the valve chest; but the engine, controlled as it is by a fixed cutoff, cannot exceed the load which that cutoff permits it to carry. The result is a falling-off in speed, with an increase in the quantity of water pumped, while the full horsepower of the engine is maintained. That is, the engine pumps all the water under the conditions, that its rated horsepower will permit. Such an engine is safe under all conditions of water level.

Used in addition to the throttling governor, a hand-adjusting cutoff is a valuable device for many services. One of its chief advantages is the fact that the engine speed can be changed while running, and can be brought to the exact value desired without shutting down the engine for access to the shaft governor. It is possible to vary the speed of the shaft governor through the medium of gearing to some extent while the engine is running, but the range of possible variation is small. With a throttling governor, the engine can be given any speed from the highest to the lowest as long as the horsepower permitted to be developed by the steam valve, as it is set, is not exceeded. It is only necessary to adjust the cutoff for the maximum indicator diagram required during the running of the engine, and the speed and power can be varied at will by adjusting the throttling governor, without interfering with the running.

Engineers having in charge centrifugal pumping plants direct-connected to engines with automatic cutoff, will do well to keep an indicator handy and take diagrams frequently under conditions which are likely to produce overloads in the manner described. It is probable that some engineers will be surprised when they inspect diagrams taken from engines in their charge, to find the amount of load under which the engines are staggering, and they may be able to correct conditions before serious damage is done.

Do Mixed Fuels Pay?

By Charles J. Mason

RESULTS obtained from tests conducted at the State Hospital in Scranton, Pa., throw a little light on this subject for one set of conditions. The object of the test was to determine whether it would pay to use a mixed fuel for the plant, the 2 fuels under consideration being, first, a clear No. 3 Buckwheat anthracite washed culm; second, a mixture of this Buckwheat with soft coal. The tests were carried out on a battery of 2 Atlas water-tube boilers, rated at 150 hp. each, with grate surface of 32 sq. ft. in each, and each test carried out for 24 hr. In both tests, the pressure was held at 100 lb., feed water supplied at 200 deg., and the steam used for general purposes about the plant.

In the first test, which was made on Oct. 7, 1914, the Buckwheat alone was used, carrying 6 per cent moisture and costing $1.20 per long ton, or 0.053,571c. per lb. The total coal fired was 11,900 lb., which gave 11,186 lb. dry coal, or 7.27 lb. per sq. ft. of grate per hour. The total ash and refuse was 3125 lb., or 28 per cent; water fed to the boilers, 86,400 lb., giving an actual evaporation per pound of dry coal fired of 7.72 lb. of water. The cost of the coal fired during the 24 hr. was $11,900 \times 0.053,571 = 638$c. or $6.38. Dividing this by 86.4 gives the cost of generating 1000 lb. of steam as $0.0738.

During the second test on Oct. 8, a mixture of the Buckwheat with a soft coal which cost $5.50 per short ton, or 0.275 c. per lb. was used, mixed in proportion of 10,200 lb. of Buckwheat to 680 lb. of soft coal, or 93.75 per cent of Buckwheat and 6.25 per cent soft coal. The total coal fired was 10,880 lb., or dry coal, 10,227, giving 6.62 lb. burned per square foot of grate per hour. The total ash was 2070 lb., or 20.2 per cent; water fed to the boilers, 82,000 lb., giving an actual evaporation per pound of dry coal of 8.01 lb. of water. The cost of the coal fired was $10,200 \times 0.053,571 = 546.4$c., plus $680 \times 2.75 = 187$ c., or a total of $7.334. Dividing this by 82 gives us the cost per 1000 lb. of steam as $0.0894.

Comparing the results of the 2 tests, it will be seen that with the all Buckwheat, the cost per 1000 lb. of steam is about 7⅓ c., and using the mixture, nearly 9 c., or, exactly, a difference of 1.56 c. in favor of all Buckwheat fuel.

On the other hand, the ash in the first test was considerably higher than in the second test, and the evaporation per pound of coal in the second test was considerably greater than in the first test. Comparing these by percentages, the mixed coal evaporated 3.76 per cent more water than the straight Buckwheat, but the money cost of using this was 21 per cent greater, due to the high price of the soft coal. The smaller amount of ashes to be handled with the soft coal would work in favor of the mixture, but not sufficiently to warrant its use.

In order to make use of the soft coal mixture desirable, the price would have to be somewhat under $3 per long ton.

As a hint of business conditions in one line, the Goodyear Tire & Rubber Co., of Akron, O., reports a 12-per cent dividend declared on its common stock, and the full time work of 7500 employes.

Accuracy of Steam Measurements

FLOW METERS AND CAREFUL OPERATION GIVE RESULTS CLOSE TO CONDENSATION

IT has been generally conceded that the measurement of fluids, such as steam, was a process accompanied by much inaccuracy and unreliability.

Any such contention may be flatly refuted by observing the following table, which is a comparison of the steam measured in an Illinois power and heating station by General Electric Co. steam flow nozzles connected to Industrial Instrument Co.'s differential pressure gages and condensation measurement by means of condensation meters of the Central Station Steam Co. and American District Steam Co. makes. These condensation meters were located on the customers' premises, all of which were metered except those of a nearby manufacturing company, which used its supply of live steam for power purposes and whose monthly consumption was estimated after a series of tests.

The table includes practically all of the steam used during the heating season of 1912-13, when steam was first turned into the heating system on Sept. 20, although no readings of the station meters were taken until Oct. 8. The condensation meters were read on the 20th of each month and the following readings of the station meters cover the same period.

COMPARISON OF FLOW METERS AND CONDENSATION
POUNDS PER MONTH

Month	Station Flow Meters Exhaust Steam	Live Steam	Unmetered	Total	Condensation from House Service
Nov., 1912..	33,886,000	873,000	930,000	35,689,000	33,961,000
Dec., " ..	44,506,000	2,173,000	930,000	47,609,000	49,736,000
Jan., 1913..	48,462,000	10,384,000	930,000	59,776,000	55,466,000
Feb., " ..	49,725,000	4,608,000	930,000	55,263,000	60,595,000
March, " ..	41,906,000	6,606,000	930,000	49,442,000	49,826,000
April, " ..	33,553,000	3,458,000	930,000	37,941,000	39,440,000
May, " ..	9,950,000	6,822,000	930,000	17,702,000	13,959,000
Totals...	261,988,000	34,924,000	6,510,000	303,422,000	302,983,000

From the above it will be noted that the difference between the condensation and flow meter readings amounts to 439,000 lb. or 0.7 per cent, which must be regarded as a comparatively small amount.

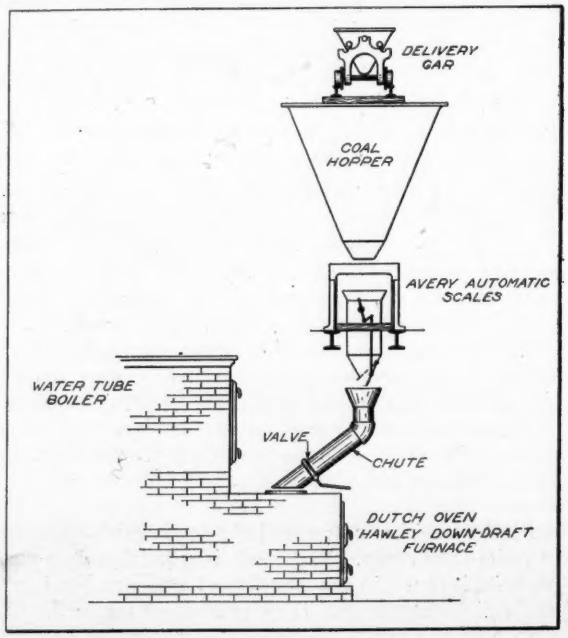
This is another result of the use of high grade measuring instruments accompanied by careful and scientific operation and emphasizes the fact that power plant owners are wise to employ first class apparatus as well as first class men.

Novel Method of Feeding Fuel

GRAVITY AS THE FIREMAN TO REDUCE LABOR AND DIRT

NORTH POINT pumping station at Milwaukee, Wis., one of the oldest and yet most modern and efficiently operated pumping plants along the shores of Lake Michigan, employs a unique method of feeding fuel into the furnaces under the boilers.

Two separate and distinct boiler plants located at opposite ends of the building supply the cross-compound and triple-expansion pumping engines with steam. The boilers, all of which are water-tube, are provided with Hawley down-draft furnaces, which, instead of being built directly under the boilers, are constructed on Dutch ovens. The object of this is self-evident by referring to the accompanying cut, which shows that the coal as delivered is dumped into the hoppers from small cars, and from these hoppers, by means of sheet-iron chutes, is fed through the top of the Dutch oven and into the furnace. As all Hawley down-draft furnaces are fed through the upper fire doors, the saving in labor gained by feeding the coal directly through the top of the furnace instead of dumping it on the floor and then shoveling it by hand as must otherwise be done, is greater than can be realized.



METHOD OF FEEDING HAWLEY DOWN-DRAFT FURNACES AT MILWAUKEE WATER WORKS

For each battery of 2 boilers, there is placed below the hopper and between it and the chute an Avery coal scale, which dumps and registers every 100 lb. of coal it receives.

A new 20,000,000-gal. Allis-Chalmers triple-expansion pumping engine which has been installed in this station will be placed in operation about Oct. 1, and will be used for the city's high-pressure supply.

ANALYSIS OF the effect of compression on steam consumption, as shown by experiments at Cornell University some time ago, showed that the least compression consistent with quiet running was best. Further study on tests made by various European experimenters indicates that for small noncondensing engines, compression to 30 or 40 lb. above atmosphere gives best economy, beginning compression at 0.1 to 0.2 stroke, and that this should not increase for earlier cutoff. For condensing engines, compression should begin slightly earlier; but the final pressure will be less.

AT SAC CITY, IOWA, the electric company is moving into a new power house, which is of concrete with a 100-ft. reinforced concrete stack and having as equipment 400 kw. in generators, 600 hp. in engines, and the corresponding outfit of high-pressure boilers, switching apparatus and distribution lines.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Well Lighted Railroad Shops

USE OF QUARTZ LAMPS INCREASES EFFICIENCY AND REDUCES CURRENT CONSUMPTION AND MAINTENANCE EXPENSES

ADVANTAGES obtained by having adequate illumination in an industrial plant are being realized by no class of operators more readily than by railroad men. Not only does the proper illumination of a shop mean a better and more efficient class of work turned out, but exhaustive tests recently made in a number of large industrial plants proved conclusively that a workman actually made a gain of several minutes a day in the production of a given piece of work, owing entirely to the better illumination with which he was supplied. These few minutes when multiplied by a large number of workmen amount to a considerable item.

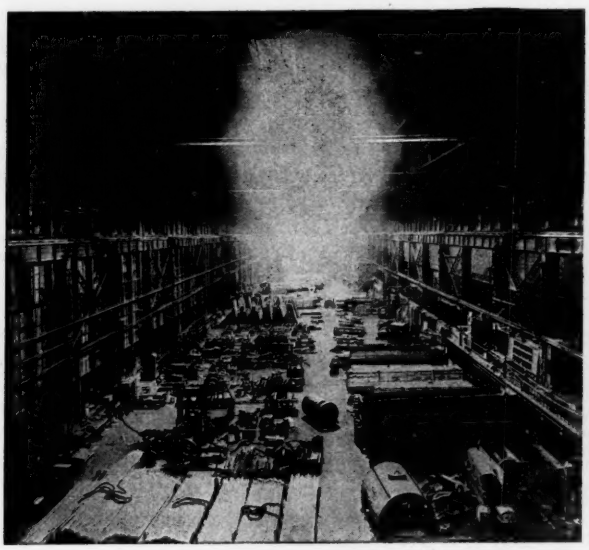


FIG. 1. BOILER SHOP ILLUMINATED BY COOPER-HEWITT QUARTZ LAMPS

Herewith are shown some views of excellently lighted boiler and erection shops of a prominent eastern railroad, and a glance at the photographs, which were taken at night, proves that the illumination is abundant but entirely without glare or shadows, reaching every part of the shop. Each building is 528 ft. long by 58 ft. wide, giving an area of 30,624 sq. ft.

Illumination for these buildings is furnished by Type Z Cooper-Hewitt Quartz lamps operating on a 220-v., direct-current circuit. This lamp is a modification of the usual Cooper-Hewitt lamp, based on the same fundamental principles, but possessing some essential differences, such as the use of a short tube of pure fused quartz istead of the long tube of lead glass used in the older types.

The lamps are placed at regular intervals of 52 ft. down the middle of the boiler shop, each lighting an average of 3062 sq. ft.

In the erecting shop are 12 lamps regularly spaced down the middle of the building at intervals of 44 ft., giving an average space lighted by each lamp of 2552 sq. ft., each lamp being hung at a height of 50 ft. above the floor.

FIG. 2. ANOTHER VIEW IN THE BOILER SHOP

The lamps are rated at 2400 cp. with an energy consumption of 725 w., or a total for the installation of approximately 16 kw. and the light afforded by these lamps is entirely sufficient for all purposes, even the locomotive pits being well illuminated. The only other form of artificial light required is a portable hand lamp needed by the workman when he goes inside the boiler.

The total lumens per lamp from these units is 14,603, with a total available in a zone of 0 to 60 deg. of 10,800 lumens per lamp which, with a wattage of 725, gives a value of 20.2 total lumens per watt, and 14.9 available lumens per watt.

Efficiency of the system as installed is made evident from the low wattage consumption obtained per square foot, these being 0.28 for the erecting shop, which is said to be the best lighted erecting shop in the country, and 0.24 for the boiler shop. The average candle-feet obtained are 4.24 for the erecting shop and 3.53 for the boiler shop.

No better evidence of the success of the installation from a practical viewpoint can be secured than the universal commendation of the employes who are working under the light. All are pleased with it and the results they are able to obtain.

FIG. 3. ERECTING SHOP USING QUARTZ LAMPS

It is interesting to note, however, that when a trial installation of 4 lamps was first made, there was a certain antipathy to the light on the part of the men employed, because of the difference in color value; but this speedily disappeared after they gave it a thorough trial, this trial resulting in the adoption of the complete installation of these units.

The lamps have been installed at various times; but the entire installation averages practically 16 months and the maintenance charges for the period total $134.54, or $4.58 per lamp per year.

Ordinary Danger in Electrical Work

HAZARDS OF SHOCK, BURNS AND DESTROYED VISION WHICH ARE BROUGHT INTO THE ELECTRICAL WORKER'S DAILY LIFE. BY T. H. REARDON

HAZARDS which are purely electrical in performing the work of the stationary engineer or the electrician around a power plant may be broadly divided into the 3 following groups or classes: injuries that result from the passage of a current through the body, burns caused by arcs, short circuits, etc., but where the electrical shock is absent, and those injuries which result from the last mentioned causes in which the vision suffers as a result of the intense light of the electric arc.

Many times it happens that the victim suffers all the injuries mentioned as a result of some unfortunate occurrence due either to his own oversight or to the negligence or carelessness of someone else. While "safety first" is a slogan echoed far and wide and while the train of disasters that follows in the wake of ignorance, carelessness and indifference weighs heavily upon employer and employe alike, it is seldom that any really specific advice, either verbal or written, is tendered those in the field of danger.

The advice to treat all wires as if "alive" is, though excellent, impracticable, as when protection becomes an incumbrance it will be neglected.

Much confusion exists among engineers and electrical workers as to the relative hazard of high and low voltage and alternating and direct current. It must be borne in mind that it is the amperage or current flow through the body that really constitutes danger and this is only indirectly connected with the voltage; but all other things being equal, it is true that the danger increases with the voltage.

The conclusion must not be drawn from this that a high voltage is necessarily fatal and that no danger at all may be apprehended from as low as 110 volts. The flow of current, even when passing through a human body, is based upon Ohm's law, that current flow is equal to voltage divided by resistance, and if a good contact is made, the value of the resistance may be so low that a heavy flow of current may result, even with low voltage.

The only difference in severity between an alternating-current shock and a direct-current shock is that the maximum value of the alternating voltage is 1.414 times the effective or stated value and it is these higher voltage pulsations which are so noticeable.

One other danger in alternating-current circuits is that, when dealing with a circuit connected to the secondary of a transformer, there is a remote possibility that the insulation between the windings may be broken down or in poor condition and as a result the operator may receive the primary or high-tension voltage.

When working upon a pole, ladder or staging it is advisable to secure oneself with a safety belt, and it is also of highest importance to throw some form of shield over and around any nearby lines, pipes or iron girders, which are only too ready to complete a circuit through to the ground.

A pair of light and dry cotton or leather gloves are of great assistance in regular all-around electrical work and while not affording a high degree of insulation, often in case of accidental contact with a circuit carrying 500 or 600 volts, they will allow the wearer to escape injury. It should, however, be remembered that no glove of any kind can be depended upon for absolute safety.

IT IS EXPECTED that the new power plant at Scotland Neck, N. C., will be ready for operation in about a month. This is an extension of the municipal plant, made necessary by the growth of the town and the additional use of light and power by the citizens.

Public Service Rates*

By Henry D. Jackson

Cost of Service vs. Rate

It is now worth while to examine into the receipts of the company for the various characters of power, and note what percentage is paid by these different characters so as to determine if possible whether the charges made against the various types are equable. The power delivered to the various characters of customers is as follows:

Total kilowatt hours sold for commercial lighting 67,063,489
Total kilowatt hours sold for power.....25,471,222
Total kilowatt hours sold for street lights....17,739,443
Total kilowatt hours sold to street railways... 8,318,756
Total kilowatt hours sold to other companies.. 4,247,904

For convenience and in order to show the relative amounts graphically, Fig. 1 is appended. From a study of the situation as it has existed for a number of years. it has been found that approximately 20 per cent of the power generated was sold to the 10-cent customers, and this 20 per cent is also shown on this sheet in order to show the relative amount of power sold to those lighting customers who pay from just under 10 cents downward, as compared to that sold to those who pay 10 cents. It will be noted that of the total power sold, 54.5 per cent is sold for commercial lighting; 20.85 per cent for power; 14.45 per cent for street lights; 6.75 per cent for street railways; 3.45 per cent to other companies.

There is also shown on this sheet the relative income from these different sales. The commercial lighting returns 66.6 per cent. Of this, 38.5 per cent comes from the small customers or the 10-cent class, and 28.1 per cent from those paying less than 10 cents. Income from power 17.3 per cent; street lights 12 per cent; street railways 2.2 per cent; and other companies 1.9 per cent. Note the comparison between the amount of power sold and the income returned.

It will be noted that the total power sold to the 10-cent customers for lighting is almost identical with the total power delivered to the motor customers. The income, however, from the small lighting customers was $2,456,815, whereas the income from motor service was $1,114,600, the return per kilowatt-hour being 4.36 cents for motor and 10 cents for light. The total return per kilowatt-hour for commercial lighting was 6.34 cents and for commercial lighting other than paying 10 cents, was 4.2. The return per kilowatt-hour for other service was: Street railways 1.72; street light 4.51; and other companies 2.87, showing very conclusively that none but the 10 cent power was paying its proportionate share of the operating, fixed and depreciation charges. It is to be noted that all of these figures other than those for the 10 cent power are average. Probably many of them pay more; in that case there must be a very considerable number who pay much less.

Some Cost Figures

Let us examine somewhat into the costs of supplying these loads, taking first the power. The peak of the power load is responsible for 38,400 kw. of the station capacity, this being based on the proportionate peak of the power load as compared to the total capacity of the plant. The total investment per kilowatt capacity of this plant is $379. Therefore, it does not seem unjust to assume a cost of $300 per kilowatt, to cover the station and distributing apparatus, as well as such other investments as may be necessary to carry on the power load. This would represent an investment of $11,520,000. Interest on this at 6 per cent would be $691,200; the operating costs based on figures previously given would be $254,712; taxes at 2 per cent would represent $230,400; the management expense, ⅓ of the total, would represent $245,208. This charge of ⅓ of the management expense is unquestionably justified, owing to the large expense central stations incur to obtain this power load, as they are required to employ expert men both to obtain and maintain it, as well as the usual management expense for any power. For distribution expense, 1/5 of the total being $143,663, the total cost then would be $1,565,183. The total gross receipts were $1,114,624, showing a net loss of $450,559.

It is to be noticed that these figures are based on the

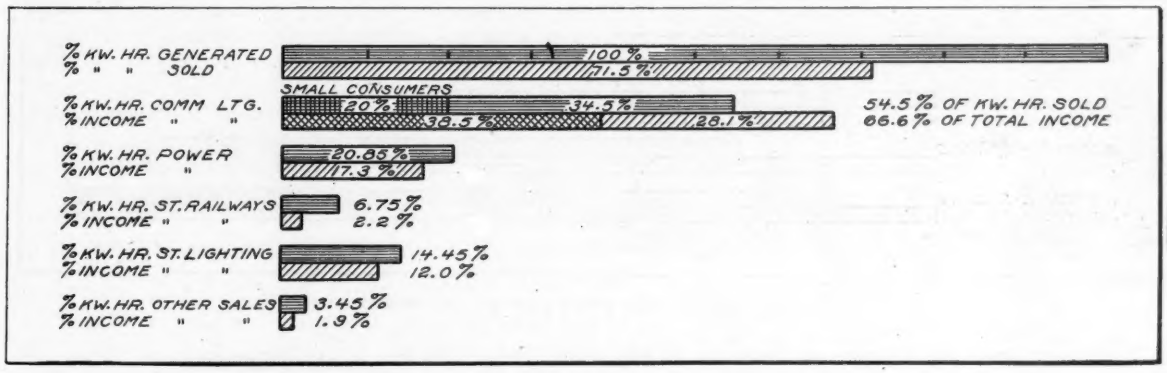


FIG. 1. COMPARISON OF LOAD AND INCOME FOR VARIOUS CLASSES OF CUSTOMERS

*Continued from page 1111, Nov. 15 issue.

entire power load. Unquestionably there is a large part of this load which is sold at a price which will return a handsome net profit, as the total average figure is 4.36 cents per kilowatt-hour. It must be evident, however, that if the total power load alone returns a gross revenue which is less than its operating costs, and a large portion of it does return a net revenue, the balance must be sold at a figure which is far below the proper charge, and that on the whole the company would be better off without the power load, for, as has been shown, the gross return is not equal to the fixed charges of interest alone on a low cost of kilowatt capacity plus the operating charges. To what extent this may apply to the large lighting load is problematical, but as this returns a gross of but 4.2 cents per kilowatt-hour, it is probable that the same would apply here, as a large portion of this load is of the same type.

Now for the small lighting load which pays 10 cents per kilowatt-hour. This requires a station capacity of 24,900 kilowatts, assuming as before that excess capacity is required in the station in order to meet the future demands as well as to cover accidents. In this case, however, we will assume the cost as $500 per kilowatt, which, as you will note, is ⅔ greater than that for power. This then would represent a total cost of $12,450,000, which, at 6 per cent, would make the interest $747,000. Taxes as before at 2 per cent $249,000; operation $245,681; for distribution, ½ of the total distribution expense, or $350,157; for management, ⅓ of the total expense, or $245,208. It is to be noted that the management charge of ⅓ is to cover the use of but 1/5 of the total output of the station, and the same applies to distribution; although ½ of the cost has been charged, it covers the distribution of but 1/5 of the power.

The total of these figures is $1,846,046; the return is $2,456,815, showing on these figures, which in every case are high, that the small lighting load returns net above all charges, $610,769; quite a different showing from that of the power.

For the balance of the current, that which is sold to the large lighting customers or all of those which pay less than 10 cents, as well as street lights, electrical railroads, and to other companies, we have to charge the balance of the interest and operating charges. These figures are as follows: Interest, $875,800; operation, $727,994; taxes, $318,217; distribution, $215,294; management, $245,208.

It is to be noted that these figures cover the distribution and management of over 59 per cent of the total distributed power, showing that a very low charge has been made for these items. The total cost then is $2,382,713; the total receipts from these sources $2,682,515, and the balance of $299,802 shows the difference above interest and other charges, or net profit, from this character of operation.

Net Revenue Returns

These various items are shown on Fig. 2, where it will be noticed that the 10-cent consumers, after subtracting the operating costs, return a dividend on the investment to the extent of 10.97 per cent; that power under similar conditions returned on the investment, interest at the rate of 2.10; and that the balance of the distribution returned 7.32. This would indicate that the power customers are obtaining their service at the expense of all of the other customers of the plant. Unfortunately, it is impossible to separate the large lighting customers from the balance of the power, neither can we separate the street railways and other customers in such a way as to get a real figure as to the peak capacities, so that this latter plot does not show up in its real light, for there unquestionably is a large proportion of this which does not pay any better than power, whereas there is probably also a good deal which pays very nearly as much as the small light consumers.

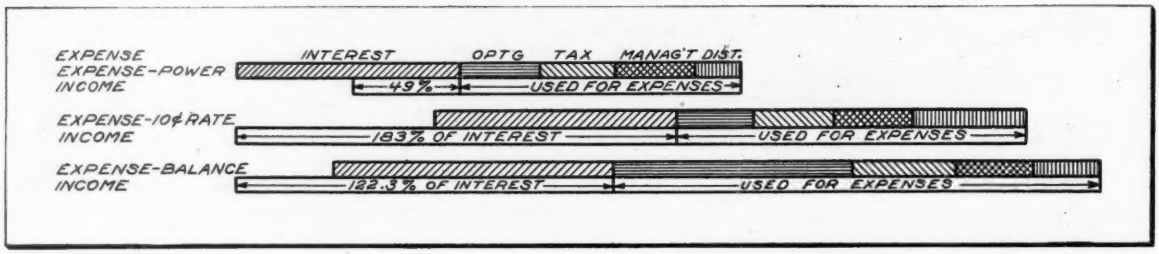


FIG. 2. EXPENSE AND INCOME FROM VARIOUS CLASSES OF LOAD

Do Big Load Customers Pay?

It is interesting to note the per cent of power delivered, and the per cent of income returned for each per cent of power delivered, Fig. 3. For each per cent of power delivered for large lighting and general service, there is returned 0.73 per cent of the income. For each per cent of power delivered for motor service, there is returned 0.83 per cent of income; whereas for each per cent of power delivered to the 10-cent customers, there was returned 1.9 per cent income.

Also note the per cent income returned for each per cent of peak capacity. The 10-cent power returned 1.54. The balance of the power 1.15; whereas power returned but 0.52.

It will be well to note on Fig. 2 that the 10-cent customers returned 183 per cent of the interest on their investment above expenses. The balance of the power alone returned 122.3 per cent, while the power alone returned but 49 per cent. All of these figures unite in showing that the small customer—that is, the one who pays 10 cents a kilowatt-hour, is the one to whom the lighting companies are indebted for their success and the one to whom they should endeavor to give as much as possible for the money and show the greatest consideration.

It goes without saying from what has been shown in preceding pages, that the small consumers are getting

least consideration instead of the greatest. They pay a large per cent of the total income and a high rate of interest on the investment required for doing their work, and yet they are given no opportunity to prove whether or not they can deliver as good or better load during the day-time than can be obtained from the large power customers or the large light customers, who, as has been shown, are given power at a price which means a loss to the company if the proper charges are made against the power delivered to such customers This is borne out by the fact that the total motor load pays but slightly over 2 per cent on the investment necessary for delivering the power when low charges of all kinds are made against it. It must be borne in mind that probably over 70 per cent of the motor customers do actually pay 6 per cent on the investment required for delivering their power. The balance then must pay very considerably under 2 per cent on their investment.

This being the case and as no depreciation charge whatever is figured in these calculations, it must be evident that these large consumers are being supplied with power at an actual net loss to the operating company. The same is true of the large consumers of power for light. The basis for the charge of the operating companies is unquestionably on the operating costs to the large consumers, and they figure that the small consumers must pay not only all of the operating costs on their power, but all of the fixed costs on all of the apparatus required for all of the power delivered. This is evident not only from the figures shown, but also from their own statement of the case that power can be delivered to these power customers at a low price because no fixed charges are necessary against such power.

Helping Out the Load Factor

So far, no attention has been paid to the amount of power that could be delivered by the power companies. The average load factor, by which is meant the ratio between the average load and the maximum load on the station, is approximately 30 per cent. This would indicate that something under ⅓ of the total power possible is delivered to the customers. This being the case, one can readily see that, if all of the power possible of generation could be delivered, the fixed charges would be reduced ⅓, or approximately 1 cent per kilowatt-hour. Not only can the fixed charges be reduced, but the operating charges would be largely reduced because under the present conditions the machinery has to be ready for operation at any time, the boilers have to be under fire, the men at hand, and, therefore, the cost in the station is probably at least ⅓ greater per kilowatt-hour than it would be should unity power factor be reached or even approached. The same is undoubtedly true as regards management and distributing charges—in fact, all of the operating and fixed costs could be reduced from ⅓ to ½ if the plant could succeed in operating at or near unity power factor. Unfortunately, such a condition of affairs is impossible, but it can be approached more or less, depending on the steps taken to gain it.

It must be evident that the large lighting and power loads and the large electric sign loads, are not likely to increase the load factor situation to any material extent. That they do increase the load is unquestionably true, but they do so at the expense of a vastly increased investment cost and the improvement in the load factor will not begin to pay even a small proportion of the interest charges on the investment necessitated by these loads. Where then is the possibility of improving this load factor?

The improvement in the load factor of some of the smaller plants should be an object lesson to the large ones. This growth has not been obtained through power loads, but has been gained through the supply of a day load to the small consumers for flatirons, toasters, stoves and other household apparatus at a price which will cover the operating and distributing charges and a fair profit, but in no case taking into account the fixed charges on the plant, because this load is maintained entirely as a nonpeak load, and, therefore, requires no investment charge. One or 2 plants have nearly doubled their load factor through these devices, doing so by selling power at prices ranging from 3 to 5 cents, making

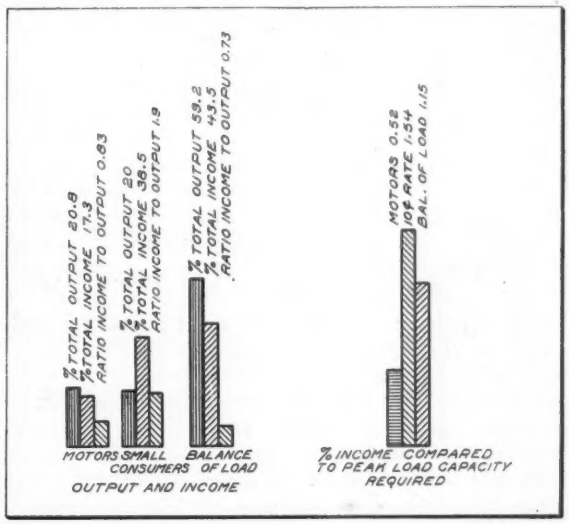


FIG. 3. RELATION OF OUTPUT PEAK CAPACITY REQUIRED TO INCOME

it possible for the householder to be comfortable in summer and obtain service in the way of heating and cooking at a price equal to or lower than equivalent service could be gained from gas or coal, in addition giving a service which neither of these could supply—that is, motive power for dish washers, ice cream freezers, and various other devices.

The same opportunity is open to the large plants. The return from such service if sold at 3 cents a kilowatt-hour, would be 2 cents net profit. Compare this with the gross return of the entire power load, which shows, even against operating charges alone, a return of less than 1 cent a kilowatt-hour; and if the proper charges are made against it, shows absolutely no return.

At present, some of the power companies are providing a service at 3 cents a kilowatt-hour for all power utilized during the day, on a separate meter from the light; and in addition are charging 10 cents a kilowatt-hour for the first 20 kilowatt-hours per month used for such service. This means that the house must be rewired for the use of this service, and that there is practically a minimum charge of $2 a month for such

service. Here again the small consumer pays the freight for the large, and he pays from 2 to 3 times as much as the large consumer of power, bringing about a similar condition to that existing between the small consumer or the 10-cent customer, and the large consumer of power, showing that while the companies recognize the possibilities of such service to a limited extent, they do not propose to lose their grasp on the enormous profits from the small consumer, and still wish, if possible, to obtain the load of the large.

Is It Rebating?

The law of the country is distinct in stating that public service corporations should treat all alike; that if there is any difference in charge between one customer and another, it must be based on a difference in the character of the load which will warrant such charge. There is nothing in the difference between the large lighting customer and the small, or the small lighting customer and the large power consumer, which will justify any material difference in the cost of current. The only justification the lighting companies have for the charge, is the ability to obtain 10 cents a kilowatt-hour from the small consumer, because he cannot make current himself for less, and the necessity for charging less than 10 cents to the large customer because he can make it for less.

Everyone knows that the reduction in the price of gas was due to the combined efforts of the people. It was in no sense due to the initiative of the gas companies. It may as well be understood now as at any other time that the small consumers of electricity will get no reduction in price nor any real improvement in service, without fighting for it. That they can get such reduction by fighting, is proved by what they have done with gas. Let them get together and demand that electricity be supplied at a price which will return a fair profit to the company and give commensurate service to the public. Rebates by the railroads to large shippers, have been stopped, and the rates have been made fair and equable to all, through the efforts of the people exerted through the Interstate Commerce Commission. What is the difference between charging a high price to the small consumers of electricity and a low price—below the cost of generation and distribution—to the large customers, and rebating? Any service which is sold below cost to one party, the difference and more being paid by another, is rebating—is it not?

It has been seen that depreciation has hardly been taken into account at all in the figures given, and the fact is that depreciation as such does not enter into the figures of many of the central stations. The reason for it is not hard to see. Any ordinary business operates with competition, and the price obtained for the product is largely settled by competition. In those cases where competition has been abolished through the formation of trusts, the Sherman Law has been invoked to prevent the abolition of competition and to bring conditions back to a normal basis. Before this condition was reached, however, many of the concerns were enabled to build up a large cash surplus, which they reinvested in their business, and upon which they now propose to pay dividends. The electric companies almost from the first were freed from competition, being under the control of the State Board of Gas and Electric Light Commissioners or some public service control.

It is to be seen, therefore, that these companies were in effect monopolies, and from the very fact that they were monopolies, they were supposed to be controlled for the benefit of the people they were serving, and still allow reasonable dividends to be earned upon the capital. Reasonable dividends were paid, but the average earnings were very considerably above the dividends. These earnings were reinvested in plant, to increase the capital account of the company. The stock was held stationary, and for some time no material increase in dividends was made. Later, however, when the plant account was considerably greater than the stock account, the dividends were increased. Any complaints resulted in the statement that while the dividends on the stock were apparently high, as a matter of fact they were paying but 5 or 6 per cent on the money invested. The fact that this money came from over-charging the consumers in the first place seems to be entirely lost sight of, so that the present condition of affairs came about from the continuous system of over-charging the small consumer, and in fact all consumers, until within recent years, at which time the large power and large lighting loads were taken on, but no material reduction was made to the small consumer who pays the largest portion of the bills. What is this condition of affairs? Briefly it is this:

The stock account is approximately ½ of the capital account, so that the stock which is paying from 10 to 12 per cent, is earning from 5 to 6 on the capital. This by the way is not new capital, but, to a very large extent, an investment of earnings on the old.

Depreciation does not need to be taken into account, because the stock sells on approximately a 5 per cent basis; and as the prospects of its earnings are still larger than in the past, the stock actually sells in the neighborhood of $275 a share. If any of the apparatus is worn out or needs replacing, new stock can be issued because the stock account is but ½ of the capital account. Therefore, if $200 is required for replacement of apparatus to cover amortization or depreciation, stock is issued to the extent of $100, $200 is put into the plant, and, therefore, into the capital account; and the $50 or $70 remaining from the sale of the stock, wipes out the amortization account. This condition of affairs can go on just so long as the companies are allowed to pay dividends on capital furnished by the consumers and not by the stockholders. In other words, just so long as the companies are allowed to pay dividends upon the money which the public has paid to the company for service not rendered.

Fire destroyed the newly installed electric light plant in Greeley, Ia., recently. The fire is supposed to have had its origin in an overheated exhaust pipe from the mammoth oil engine. The Greeley plant has been installed only a few months and was owned by the city. The engine is a mammoth concern and burns crude oil, and the supposition is that the blaze was caused from the overheated exhaust pipe. A movement is already on foot to rebuild the plant.

Jeremiah Judson, D. Ex.

EXPERIENCE DOCTOR; ON DOING WITHOUT WHEN "THERE AIN'T NO CRANE"

JERRY had been away for several weeks, down at McKeesport on a couple of big engines, and had erected them in remarkable time. In fact, he was back in the shop about the time the boys thought he would be ready to roll the frame onto the foundation.

"What did you forget, Jerry? Come back after a monkey wrench to take the skid bolts out?" chaffed Wagner, goodnaturedly.

"Me? No. Got done," replied Jerry, briefly, as became a man of few words.

"Why, how did you get done so quick?" piped up Cadwell.

"Crane," was all that Jerry would say, and it was enough for it set the boys thinking.

All went on with their several tasks, each busy with his own thoughts, but Cadwell resolved to pump Jerry at the first opportunity. That noon, after the several empty dinner pails had been laid aside, and the several brands of the noxious weed well started in the several well colored pipes, the boys climbed inside the bottom section of a jet condenser as it rested on the floor.

This condenser was 10 ft. in diameter, and the section was just the right height for a seat and flanged out as if made for the purpose of holding an impromptu lecturer, surrounded by the limited audience of 8, which was the limit for the muses that stirred the recalling device of Jerry Judson into action.

"So you had a crane down there, did you, Jerry?" said Cadwell, as a starter, bound to get a story out of Jerry some way.

"M-Hm," acquiesced Jerry, intent at the moment on increasing the draft a little in his pipe, which he stuffed with his finger, and encouraged to produce the necessary smoke. "Yep," puff-puff, "a 50—" puff-puff, "a 50-ton, and we had a good crew all around except the man who was superintendent of the rail mill 4 yr. ago."

"What about him? I sh'd think he would be a high priced man to use on a job like that," chimed in Tony Davidson. "Why did you except him?"

"Every time he saw a brewery, he tried to drink it dry,—and failed. So he dropped from $10,000 a year, to $1.75 a day, and didn't earn that. But we got through in record time and got the money."

"But what do you do when you hain't got no crane?" broke in Flannery, and apparently Jerry paid no attention to the query. Finally he said the usual thing,

"Well, sir, that reminds me of the time I did a funny job without a crane. There were several of those queer jobs when I was with that firm, but there isn't time to tell but one story today," consulting his watch.

"One time, a number of years ago, I worked for a large concern, as first aid to the injured in the several power houses, of which they had 7 or 8. They bought some new equipment and started 2 new power houses to take over the load of the several little ones, and we moved some of the old equipment into the new plants and rebuilt it. This was my task. The repairing, and re-erecting didn't bother me any, but it was getting the stuff apart that worried me some. We started in on a Corliss-driven air compressor. Let's s-e-e-, it was 20 by 34 in. steam, 26 by 16 in. air, and 36 in. stroke.

"The steam cylinders were next the frame and the air cylinders tandem behind them. When the engine was erected by the builders' man years ago, there was a clear field ahead of him and around him; but in the course of time, the surroundings were so changed with added machines and piping and other rigging all around, that you couldn't put up an A frame or anything else, and the roof trusses were not strong enough to hold any weight but the governor or a bearing cap, or light stuff like that.

"By running a 2-in. rope from one truss to the other over the frames, we managed to handle the connecting rods and piston rods. The cylinders we slipped back onto the skids and then rolled them out of the way. Finally there was nothing left but the 2 frames and the wheel and shaft. There were only 3 of us. The 2 boys were willing enough, as far as that goes, but were new at such work.

"By means of air drills, we drilled out the old links, and after gripping the shaft with the quarter boxes to keep it from turning, we dropped the lower half of the wheel into the pit about 8 in. Then our troubles began. The wheel was a 16-ft. balance wheel in halves, and weighed 11 tons. To get that off was the question.

"Finally, I got some material: 4 10-ton screw jacks, 4 8 by 8, 16-ft. Norway pine timbers, 4 8-in. heavy channels 4 ft. long, and 2 of them 16 ft. long. All these channels I lined with 3 by 8-in. planks bolted in with a few bolts so as to hold the 2 pieces together, and with all this stuff at hand, we went at it.

"Placing 2 of the 4-ft. channel irons under the hub parallel to the shaft, I put a 10-ton screw jack under each end of each channel, with the base safely set on the floor, which was built directly on top of the foundation. Borrowing 2 steam fitters, so as to have a man at each screw, we started to raise, all pulling together and in silence. There is nothing, boys, that will put things on the bum like several talking at once, like women at a quilting party, and getting everyone's mind off the work at hand.

"By means of a clamp, I fastened a common wooden level, or plumb, to the side of the wheel, so as to see at all times if we were getting it out of plumb, and liable to tip over. When we had raised the top half of the wheel as far as the screws would go, we blocked on top of the shaft with 3 by 4-in. oak blocks edgewise, built a block house under the joint of the rim and eased back so as to release the screws, and block up under them

some more. In this way, we raised the top half of the wheel till it was 22 in. in the clear above the shaft. The next step was to run in 2 of the 8 by 8-in. timbers, setting them as far apart as the jacks would permit, blocking them well, and perfectly level, both lengthwise and crosswise, taking care that when everything settled, the timbers would not ride on the shaft.

"On top of the timbers, we placed 4-in. maple rollers every 3 ft. or so, and on top of these, the 16-ft. channels, under the 4-ft. channels crosswise under the hub. Then we placed 2 more 4-ft. channels crosswise under the rim, taking care to insert wood veneer, or cardboard, where the bearing was iron to iron, and thus prevent slipping; and when we eased off on the 4 jacks, there we had the wheel, safe on rollers. By means of a 1-ton chain tackle lying on the floor, with the rope threaded under a hydraulic pump and between 2 engines, we rolled that wheel off at a little angle onto a well blocked skidway and clear of the engine, but about 5 ft. from the floor. The wheel just passed under the trusses supporting the roof.

"As the boy said, 'the worst was yet to come'; for, since there was a jog of about 6 in. in the floor level, between where we were and where we wanted to land the wheel ultimately, we had to do a funny stunt under trying circumstances, by lowering the wheel on its steel skids, with the rollers under that, and the 8-in. track, or skidway under that, till we got the 8-in. track about 4 in. from the floor, when we blocked one end of one skid, put rollers under the other side, and cross rollers of 2-in. pipe at the other end. In this way, we skewed the wheel off in a new direction and, when headed right, we removed all the blocking and pipe rollers under the 8-in. track, letting it down onto 2 planks.

"By using double planks on the raised portion of the floor, we now had a level track to the final landing place, where we bolted 8 by 8-in. timbers 16 ft. long on the side of the wheel as it stood and building a cob house at the right height so that the wheel would rest on it when overbalanced, we put a pump jack under one side and tipped the wheel over. All this was necessarily done right in front of the switchboard. It did not fall over 4 in. after overbalancing, till it rested on the cob house; once there, it was an easy matter with jacks to remove the blocking a little at a time till the wheel rested on skids on its side on the floor.

"The next job was the shaft. Sliding the 4 eccentrics away from the bearings, we were able to place 8 by 8-in. skids under the shaft on jacks. After removing the bearing caps with the chain tackle hooked onto the rope between the trusses overhead, we jacked the shaft up, easing off and blocking as necessary, till the shaft cleared the bearings, when it was rolled out in front right onto the saddle, ready to receive it, and bolted down on its skids and slushed.

"Before the lower half of the wheel could be removed, it was necessary to get the frames off and out of the way; but, as the anchor bolts were grouted in, this was no small job, the bolts being 2-in. I had several dozen steel wedges made and placed them under the frame every 6 in. or so all around and followed around with sledges. At the end of the first day, we had just begun to see daylight under the frame. By noon the next day, we had raised it about an inch. Then we found that about a ton of the top of the brick foundation was adhering to the frame and that was what made it so hard to start. The other frame was the same way; however, we finally got the frames raised about a foot, but it was out of the question to raise them above the top of the longest bolts, so with an air 'gun' we cut all the bolts off,—some task in itself. With the 2 frames out of the way, we next tipped the lower half of the wheel over as far as it would go in the pit, and with heavy pump jacks, finally shoved it up out of the pit, on greased boards by 'main strength and awkwardness.' Once on the floor, it was easily put on skids.

"Down cellar, away back in the darkest, hottest corner they could find, where the grease and oil were well mixed with missing wrenches, old pipe, tin cans, and scrap iron, was the intercooler. This delicate little arrangement weighed 9 tons, and was located crosswise back of the foundations. We had had to shore up the floor overhead to support the weight of the engine as we took it apart and set it aside out of the way, so when we started to remove the intercooler and turn it quarter way round, we had some task removing shores and replacing them in different places. But finally we managed to turn the intercooler around, headed up between the 2 foundations, where the wheel and receiver had been, and without bringing down the 4 cylinders and other crated stuff on top of us, like Samson of old.

"In skirmishing around the yard back of the shop, I found 2 channel irons 10 in. wide and 30 ft. long. Without consulting anyone, I just appropriated them, well knowing that some bosses won't let you have what you want. I put these as an incline from the cellar to the main floor up through the flywheel pit. Of course, we had to cut 6 in. off several of our rollers for the job; but with the chaintackle, using a 'drag wedge' for safety, we snaked the intercooler out on the floor, reeking in oil and grease. All in all, we got along very well without a crane, although we had but 3 of us for all of the work except the top of the wheel, as has been mentioned, and we didn't have an accident of any kind, nor even blacken a finger nail.

"Well, boys, there goes the one o'clock whistle," completed Jerry, as he knocked the ashes out of his pipe on the edge of the condenser and we went "back to the mines."

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERING will hold its 1914 meeting Dec. 28 to 30 at Chicago. Sessions will be held Monday evening, Tuesday morning and afternoon, and Wednesday morning and afternoon, devoted to engineering as applied to problems arising on the farm. Tuesday evening will be given up to a social and banquet, and Wednesday afternoon to inspection trips.

IMPROVEMENTS which the Spencer Electric Light and Power Co. has been making during the last summer and fall at the power plant at Smyrna, Mich., have been practically completed, and it is expected that by Nov. 10 the company will be supplying light and power from its own plant once more. While the improvements have been in progress the company has been making use of the electric plant of the Richardson Silk Co.

Baldwin Articulated Locomotive

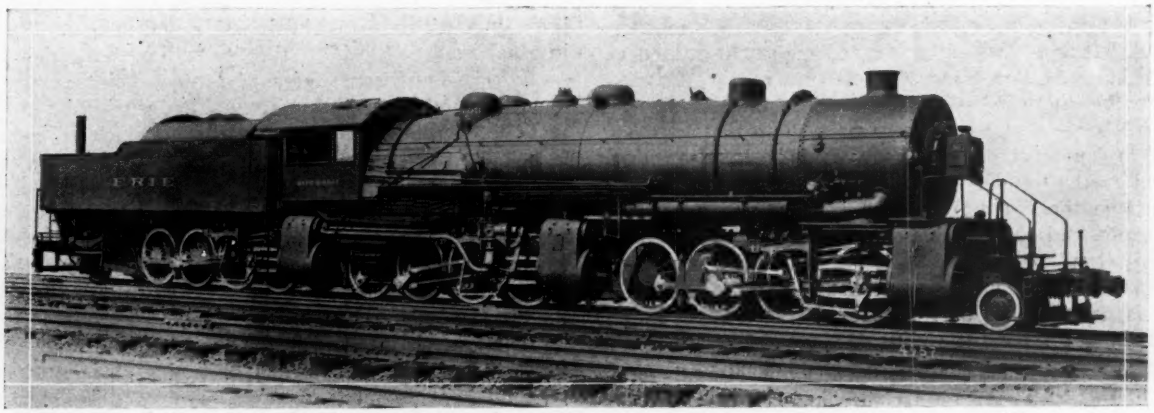
415-Ton Engine Built for Pushing Service on the Erie R. R.

FROM time to time, the locomotive weight record is broken by the construction of an engine heavier than any that has preceded it. This has recently occurred in the case of a locomotive built by The Baldwin Locomotive Works for the Erie R. R. The most unique feature of this machine is that the tender is driven by steam as well as the engine, and the weight of the tender can therefore be consistently included as part of the weight of the locomotive. Hauling capacity of any locomotive is primarily dependent upon the weight carried by the driving-wheels. In the present instance, a large part of the weight of the tender is carried on driving-wheels.

This locomotive is a modification of the Mallet articulated type, which is used on a number of roads for heavy pushing and freight service. It is carried on 28 wheels—a 2-wheeled truck at each end and 24 driving-wheels, which are divided into 3 groups of 8 wheels each. Two of these groups of wheels are placed under the locomotive proper, while the third is under the tender. Each group of wheels is rotated by a separate pair of cylinders; so that there are, all told, 6 cylinders under the locomotive. These cylinders are all of the same size, but they are arranged to operate on the compound principle. The 2 cylinders which drive the middle group of wheels are the high-pressure, while those which drive the front and back groups are the low-pressure. The steam, after leaving the right-hand high-pressure cylinder, passes to the 2 front low-pressure cylinders; and after being expanded in them it exhausts up the stack in the usual manner. In a similar way, the steam from the left-hand high-pressure cylinder passes to the 2 rear low-pressure cylinders; and after being expanded in them, it escapes up an exhaust pipe at the rear end of the tender. The ratio of expanding, in this locomotive, is therefore as 1 to 2.

The tender section of this locomotive is flexibly connected to the engine, and there is also a flexible connection between the frames of the first and second groups of wheels, which enables the locomotive to traverse sharp curves without difficulty. The boiler is rigidly supported to the frames of the second group of wheels, and is carried on the front frames by sliding bearings. The pipes connecting the high and low-pressure cylinders are fitted with flexible joints, so that they can adjust themselves easily when the locomotive is passing around curves.

The boiler of this machine is of unusual size, and is fitted with what is known as the Gaines furnace, with a grate area of 90 sq. ft. The front section of the firebox is separated from the main section by a bridge wall and firebrick arch, and is used as a combustion chamber, heated air being admitted to the main furnace section at the top of the wall, in order to aid combustion. The boiler also contains a superheater, which effects a considerable saving in the amount of fuel and water which must be consumed to develop a given amount of power. Another feature of the equipment of this boiler is a Street mechanical stoker, by means of which coal is automatically conveyed from the tender and blown into the firebox by steam jets. It would be practically impossible in a locomotive of this size, to maintain the steam pressure with hand firing when the engine was developing full power.



BALDWIN LOCOMOTIVE FOR PUSHING SERVICE

This locomotive has a height of 16 ft. 6 in., and a maximum width of 11 ft. 3 in. The distance between the centers of the front and back wheels is 90 ft., and the total length is 106 ft. The tender carries 10,000 gal. of water and 16 tons of coal, the total weight of the locomotive with tender section, loaded and ready for the road, being approximately 415 tons. The engine is named "Matt H. Shay," in honor of one of the oldest engineers on the Erie Railroad.

This locomotive develops a tractive force of 160,000 lb., when working at its full capacity. It has driving-wheels 63 in. in diameter, and cylinders 36 in. diameter by 32 in. stroke. The boiler carries a steam pressure of 210 lb. per square inch and has a total heating surface of 6886 sq. ft.

Whether locomotives of this unusual capacity will ever be used for regular freight traffic, remains to be seen; but there is unquestionably a field for such machines in pushing service on steep grades, and it is for work of such character that this engine has been designed.

Points About Banding

AVOIDING SHORT-CIRCUITS AND CONTRACTION OF THE BANDING WIRE. BY GORDON FOX

BANDING wire is an important part of the small direct-current armature, inasmuch as it is depended upon to withstand the centrifugal strains and to hold the armature coils in place. Not infrequently, band wires are damaged and must be replaced, hence some suggestions are offered concerning the work.

One point deserving mention is that of the location of the little brass clips used to hold the bands in place. In the process of banding, the insulating strip is wrapped about the armature and held down by a cord. At several points, narrow brass strips about 3/8 in. wide and 1½ in. long are slipped under this cord with the long dimension parallel to the armature shaft. The band is then wound on over these clips, the clips folded up over the outside of the band, cut off and tapped down snugly upon the band, then soldered.

A little thought will show that the band wires themselves are conductors which are rotating in a magnetic field, but as the wires run around the armature and not parallel to the shaft they do not cut across the magnetic flux, and there is little voltage generated in them. The clip, however, is a conductor parallel to the shaft, cutting the magnetism, and if one clip is under a south pole and one clip under a north pole, there will be a circuit through the 2 clips with the band wires as end conductors, and considerable current will flow through this short-circuited path, heating the band wire, causing it to expand and loosen and perhaps to become displaced. It is thus evident that we should insert but a limited number of these little clips.

For a 4-pole armature, 2 clips diametrically opposite are best since both are then in like magnetic fields. A 6-pole armature had better have 3 clips 120 deg. apart, for the same reason.

Sometimes after a band is in place, it is tinned or soldered over its entire surface, which practice is not commendable, since the band is then totally short-circuited and the currents generated in it are likely to cause serious results. It should hardly be necessary to state that in soldering band wires no acid should be used, as any leakage will injure the armature insulation.

Another point in banding is the means of obtaining the tension. Ordinarily, this is accomplished by simply clamping the wire between holders similar to a vise, thus creating friction between the wire and the holder. There is a very real objection to this method; the band wire in sliding through the clamp is heated, materially, by the friction, consequently is in an expanded condition when placed in position on the armature. When it cools, it may be too tight and may stretch or break, the exact amount of tension being indefinite since it depends upon the temperature of the wire. It is better in banding to wind the wire about a drum and to use friction to retard rotation of the drum, the wire passing from the drum to a roll guide, thence to the armature. In this way, the heating effect of the friction does not reach the wire, which is wound while cool so that its tension is more definite and dependable.

Automatic Timing

METHOD OF INSURING REGULAR SYSTEM OF FIRING BOILERS

IT is conceded that systematic firing has many points of superiority over the haphazard method, but one difficulty in securing this end has been to get the regular and uniformly timed attention of the boiler room force. This is not necessarily due to unwillingness, but simply to the difficulty, under boiler room conditions, of keeping track of the time of the last firing, and the time which has since passed.

An apparatus manufactured by the Timed Impulse Machinery Corporation, of South Brooklyn, and sold by the Merchant Engineers Corporation, 30 Church St., New York, called the Bonner Automatic Timer, has been devised to overcome this difficulty. The mechanism is electrically actuated, and is intended to produce, at predetermined intervals, the flashing of numbered lights and ringing of gongs, to indicate the period at which certain duties shall be performed. The apparatus is composed of 4 parts: a selecting switch of rotating lever type, with external knob handle and indicator, and internal revolving bridge, through which connection is made across different series of contact points; a frequency drum driven through reduction gearing by a direct-current motor; a sequence drum, which is maintained by a compound spring motor in position to revolve whenever released by an escapement lever, this escapement being operated by a solenoid whose action is controlled by impulses from the frequency drum; field indicators, consisting of lamp signals, gongs or other apparatus, arranged as may be required to give the signals in the boiler room.

The timer is installed in the engineer's office, so that he can set the selecting switch, or timing device, to correspond to the amount of steam required. The signals in the boiler room will then be given at the intervals desired, and the firemen can regulate their firing according to these signals. The frequency of the signals can, of course, be changed by the engineer, according to the load being carried, and the boiler attendants can be instructed to fire a certain amount of coal each time, according to what is found to give the best results; thus the amount of coal fired each time multiplied by the number of firings will give a record of the coal used.

It is interesting to note that by the use of one of the earlier types of this apparatus, a large New England concern saved over 1400 tons of coal a year, and eliminated practically all of the smoke, which had formerly been a landmark, from its chimney.

The device may, of course, be used for many other purposes, such as controlling the operation of ventilating apparatus, dispatching of trains, periodic supply of feed water, in fact, any series of operations which require performance at regular intervals, according to a definite schedule, or according to a schedule which can be fixed, from time to time, by the official in charge of the plant.

THE BETSON PLASTIC FIRE BRICK CO. is moving its business into a larger plant to secure increased facilities, and will in future be found at 244-46 E. Dominic St., Rome, N. Y.

Foreign Development in the Power Plant Field

UTILIZATION OF NATURAL STEAM IN ITALY. BY J. H. BLAKEY

IN the north of Tuscany, Italy, near the town of Volterra, is a region where is found a large number of boracic springs, some of warm water containing the boric acid in solution, called "lagoni," and others of natural steam, which are called "soffioni." During the early part of the last century, plants were erected in the district for the purpose of extracting the boric acid from the warm water. Simple at first, these plants were soon extended, and the industry was largely developed in consequence of the discovery of an economical process for the extraction of the acid. This process, which is still in use, consists in collecting the natural steam of the soffioni and using it to evaporate the warm waters of the lagoni, which are heated in leaden boilers. At the present time there are 7 plants scattered over the region, and these collect water from 71 lagoni, and from more than 300 artificial borings.

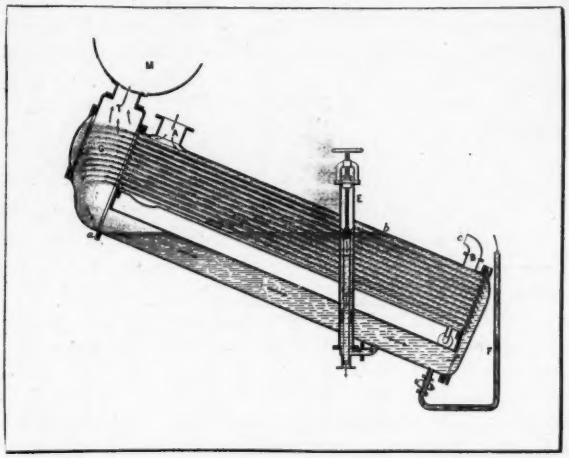


FIG. 3. SECTION SHOWING THE SYSTEM OF TUBES

The amount of available steam being known, the question arose whether, besides the production of boric acid, it would be possible to use the steam for the production of power, either by operating dynamos or by some other method, in making use of the recent progress in the development of the low-pressure turbine. A difficulty, however, presented itself. It was found that the natural steam contained about 4 per cent by volume of a noncondensible gas, as well as an amount of hydrosulphuric acid sufficient to make it unsuitable for use in a turbine, on account of the injurious effect of the acid on the vanes. It was therefore necessary to provide a boiler in which the natural steam could be used to produce steam from pure water.

The Societe des Procedes evaporatoires du systeme Prache et Bouillon was set to work on the problem, and they erected a battery of 4 boilers, which is shown in Fig. 2. The different units are inclined at the same angle, and surmounted by a collector. Figure 3 gives a cross section of one of these units, showing the system of tubes, which are about 1¼ in. in diameter and 12 ft. long.

The natural steam from the soffioni reaches the installation by the pipe A; then, after circulating around the tubes, leaves the first unit by the opening B, and passes by the pipe C, to the upper part of the second unit. From the fourth, it passes out into the air through

FIG. 1. BORINGS OF THE SOFFIONI

D. The speed of the steam diminishes in proportion to the number of units, but it is found that with 4 the final speed is sufficient to carry off the noncondensible gases and keep the passages clear. Each unit is filled with pure water to the level, ab, regulated by the regu-

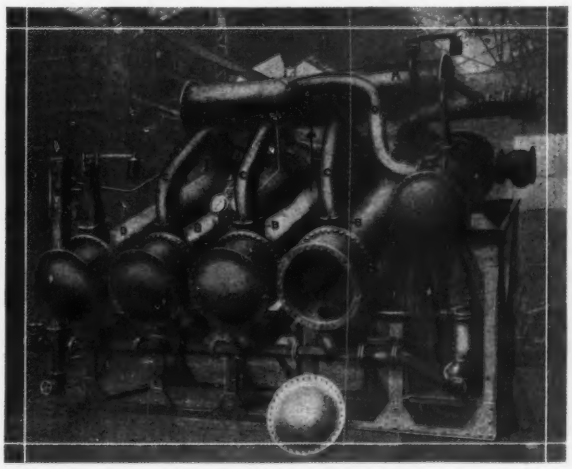


FIG. 2. BOILERS AND COLLECTOR

lator, E. The feed water is brought by the pipe, F, connected to an overhead tank or to a pump. The steam from the water in the tubes is driven against the circular plate at the upper end of the boiler, which acts as a separator, the partly dried steam rising and passing into

the receiver, M, and the moisture falling and re-entering the water. From the receiver it passes into the drier, S, where it is further dried and given a certain amount of superheat by circulating through tubes which are surrounded by fresh steam brought from the main A by the pipe V. From the drier it is conducted to the turbine.

The battery of boilers furnishes steam for one turbo-alternator, which produces the electrical energy for the plants of the region, and also for the town of Volterra. It receives hourly at a pressure of 7.7 lb., 6300 lb. of natural steam from the soffioni, and produces about 5500 lb. of steam at a pressure of 7.2 lb., which is about 564 lb. per sq. ft. of heating surface. The low-pressure turbine consuming approximately 30 lb. of steam per kilowatt, the electrical energy produced is in the neighborhood of 180 kw.

The success of the present installation has been such that another of 1800 kw. is being put in, and plans are being made for others of still greater capacity.

Mechanical Cooler for Water and Other Fluids

INGENIOUS CONSTRUCTION USED TO OBTAIN A LARGE AMOUNT OF SURFACE IN A SMALL AMOUNT OF SPACE

A MECHANICAL cooler of unusual design has been devised by Messrs. Heenan and Froude, Limited, of Worcester, Eng., for cooling the circulating water of internal-combustion engines, the condensing water of refrigerating machinery, the circulating water of air-compressors, and the like, plants for one or other of these purposes having been installed by the patentees in many quarters of the world. In these machines the water is cooled by exposing it in thin films to a current of air forced over it by means of a fan.

As will be seen on reference to Figs. 1 and 2, the machine is of simple construction, consisting of a number of cylinders, each of which is built up of galvanized-steel sheets, which are wound spirally onto a cast-iron center. This winding is done by special machines which leave a small space between the courses of the spiral for the passage of the air. The cylinders are mounted on a horizontal shaft carried on ball or roller bearings fixed to the end plates of the tank. The water contained in the tank is automatically maintained at a certain level by means of a ball-float valve, while air is driven by a fan through the spiral spaces of the upper half of the drum—that is, of the parts which are above the water-line. With this form of construction an enormous amount of surface can be packed into a small space. The cylinders described are rotated at a slow rate, so that the surface of the drums is kept continuously coated with the water or other liquid to be cooled. The cooling effect is obtained partly by direct conduction of heat from the liquid to the air passing through the annular spaces, but also in most cases by the evaporation thus promoted, since the vapor drawn off by the air carries with it its latent heat.

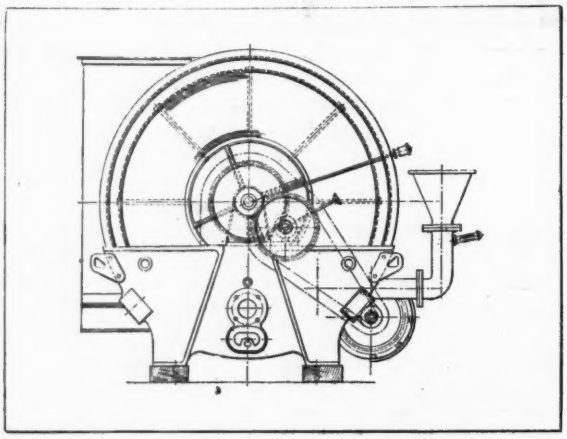


FIG. 1. END VIEW OF HEENAN COOLER

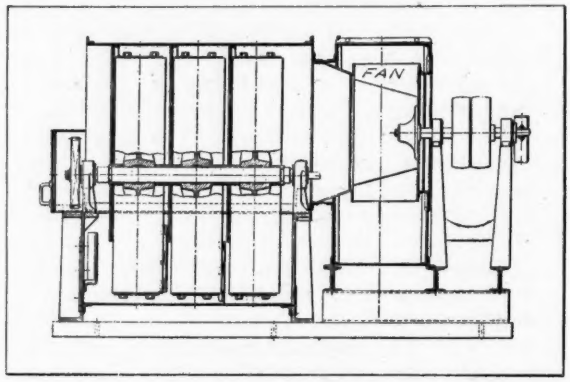


FIG. 2. LONGITUDINAL VIEW OF HEENAN COOLER

It should be pointed out that as the water is spread over the cooling surfaces in a thin film, it is impossible for the suction of the fan, which draws the air through the machine, to cause the water to heap up on the edges of the plates, forming globules or drops which would be carried away by the outgoing air in the form of spray; hence the only water lost is that due to evaporation, and the cooler is thus economical with regard to the make-up supply. To pass the necessary volume of air through the special drums a fan is used, either of the centrifugal or propeller type, according to the size and type of the machine, a centrifugal fan in a number of cases being found to be the more efficient. The drums are rotated by a side shaft driven by a chain from the fan shaft, as best seen in Fig. 1. As the air current is provided by a fan, the efficiency of the plant is independent of climatic conditions.

An interesting feature of this type of machine is that it can be arranged for ventilating the engine-room as well as for cooling circulating water, the cooler being installed in the engine-room, and arranged with an outlet duct from the fan discharge through the roof or wall to the outside of the building.

A special and compact form of the cooler has been developed for use on shipboard, where auxiliary light-

ing sets are now frequently driven by oil-engines. In this the fan is mounted on the top of the tank, and a chain-and-spur gear-drive is arranged between the fan-spindle and the drum-shaft; the steel-plate cover over the drums in the standard cooler is done away with by raising the height of the tank sides sufficiently to eliminate any possibility of water splashing out due to the rolling or pitching of the ship. Another special application of the cooler is for the cooling of oil used in the tempering and hardening of metals, such as steel forgings, castings, etc. The continuous cooling of the oil-bath increases considerably the output, at the same time eliminating all possibility of fire due to the oil becoming overheated.

One of the most interesting applications of the Heenan cooler is in connection with filtering and cooling the air-ventilation supply of electric generators. In this application, difficult conditions have to be dealt with. In the first case, it is essential that there should be no trace of spray in the air entering the generator, as otherwise there would arise the danger of short-circuits in the winding and consequent fire. The drums of the cooler are practically the same as used in the water-coolers, and are rotated by a single worm-reduction gear, the worm-shaft being extended and fitted with a pulley to be driven by a small motor. On account of the water being spread in a thin film over the surfaces, it is impossible for any loose moisture to leave the machine and enter the generator. Further, as a certain amount of evaporation takes place due to the passage of the air over the wet surfaces, a large cooling effect is obtained, the temperature of the air being reduced sometimes by as much as 20 deg. F.

Further use of this machine as a filter or purifier is in connection with breweries, where a supply of purified and cooled air to the refrigerator and tun-rooms is of great importance, particularly when the breweries are situated in industrial districts where the air is laden with dust and impurities. In such cases the plant consists of a machine built up on the same lines as the filter mentioned above, the air being blown through the machine by means of a forced-draft fan, and delivered to the various rooms through ducts having specially designed orifices. The simplicity of the apparatus enables large volumes of air to be dealt with at a low expenditure of power.—Engineering, London.

Mason Photographic Contest

In the Photographic Contest recently conducted by Mason Regulator Co. to secure illustrations and methods of use of their regulators, the judges, F. L. Fairbanks, chief engineer of the Quincy Market Cold Storage & Warehouse Co., E. H. Kearney, and Albert C. Ashton, treasurer of the Ashton Valve Co., after going over some hundred or more entries, have chosen as the winners the following: H. N. Downs, 5 Haward Ave., Shelton, Conn.; Geo. Van Vlack, 416 Flower City Park, Rochester, N. Y.; W. H. Odell, Yonkers, N. Y.; C. Cooper, Portland Ry., Light & Power Co., Portland, Ore.; A. H. Cutler, Eureka Silk Mfg. Co., Putnam, Conn. Ovide Vachon, Beauport, Que., presented a sketch and description, which was considered worthy of a special award of $10, but not eligible as a winner, because of presenting a sketch instead of a photograph.

Turbo-Generators for the United Illuminating Co.

THE United Illuminating Co., New Haven, Conn., has arranged to add to the equipment of its Grand Ave. station in New Haven, 2 4000-kw. Curtis steam turbo-generators, and to the Congress St. station at Bridgeport, Conn., 2 2500-kw. Curtis units of the same type. The contract to build these machines and all accessories has been awarded the General Electric Co. and it is anticipated that these new units will be placed in operation some time next spring.

Originally, the United Illuminating Co. was known as the New Haven Electric Co.; and when the plant was first started in 1883, on Temple St., New Haven, the equipment consisted of 4 2000-cp. Thomson-Houston series-arc machines, divided in pairs and steam engine-belt-driven. The first year the load was strictly store lighting; but during the second year, some street lighting was included and in the summer of 1886, the first house lighting was installed. A 400-amp. Thomson-Houston generator was also added at this time. Gradually the station developed until it consisted of 14 2000-cp. series-arc machines and 6 of the 400-amp. machines. In 1890, this entire equipment was moved to the new station, the present Grand Ave. building.

The old station, at present known as the George St. plant, was then equipped with General Electric generators, of which there are now 8 installed, direct-connected engine-driven in pairs. These are still operating, but will go out of service next spring and will be replaced by 500-kw. 3-unit 4-bearing motor-generator sets, which will be driven by alternating current from the Grand Ave. station, generating direct current and sending it out over the present direct current switchboard.

In the Grand Ave. station, the series-arc machines were continued in service until the summer of 1909. Then followed the installation and operation, first of a 300-kw. turbo-generator and next of one 500-kw. and one 1000-kw. unit. The remaining 6 400-amp. direct-current machines were taken out in 1911 and Grand Ave. became strictly an alternating current station. A 1250-kw. Curtis unit was installed, and later 2 1250-kw. units and a 2500-kw. unit were added at intervals. The 2 new 4000-kw. Curtis turbo-generators will be 1800-r.p.m., 6600-v., 3-phase, 60-cycle, horizontal shaft, condensing machines designed to operate under 150 lb. gage pressure, 28 in. vacuum, dry steam.

The plant at Bridgeport was started about the same time as the New Haven division, but it was first independent and known as The Bridgeport Electric Co. Development here has been virtually along the same lines as at New Haven, for the practice of purchasing generating apparatus for each station at about the same time has prevailed. The first 2 turbo-generators installed were of 300 kw. and 500 kw. capacity. Today there are in operation 4 1250-kw. units of the Curtis type manufactured by the General Electric Co. The 2 new 2500-kw. machines will operate at 3600 r.p.m. and will have the same characteristics as the 4000-kw. units in the New Haven station.

Air is as important in the operation of a furnace as coal and its use should be as carefully watched.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Cause of Wear on Cylinder

ON PAGE 1041 of the Oct. 15 issue, W. J. M. describes his difficulties with a 14 by 22-in. Corliss engine cylinder.

He states that 2 yr. ago, on account of being badly worn on the top, the cylinder was rebored, and he now finds it in a worse condition than it was before using.

The most probable cause of this wear in the top of the cylinder is due to the crosshead being low, thereby tilting the piston upwards so that it bears harder on the top of the cylinder than any other place, and as a result causes excessive wear; Fig. 1 shows this condition exaggerated.

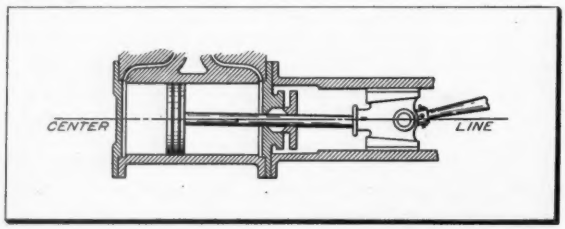


FIG. 1. SHOWING HOW WORN CROSSHEAD SHOES AND GUIDES CAUSE EXCESSIVE CYLINDER WEAR

In an engine running over, practically all the wear in the crosshead will be on the bottom shoe, and on the guides the bottom one will also receive most of the wear. Due to this wear, the crosshead drops or wears down from time to time and the center of the crosshead gradually drops below the center line of the engine.

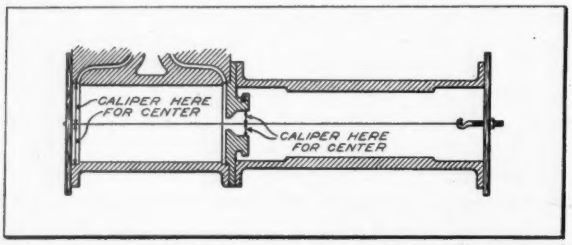


FIG. 2. LINING UP ENGINE TO DETERMINE GUIDE WEAR

There are means on the crosshead shoes to take up this wear from time to time and keep the crosshead in the center, or in other words, keep the piston parallel with the cylinder bore. If this adjustment is neglected, the result will be as in Fig. 1.

To determine whether the crosshead has dropped down and how much, run a line through the cylinder, as for lining up the engine, and by calipering between the guides and the line, the amount of wear can be ascertained; the same with the crosshead. By adjusting the shoes on the crosshead, it can now be brought up so that it is centered.

I am assuming that the crosshead has dropped down. If, on running this line through the engine, everything seems reasonably accurate and in line, the wear in the cylinder may be due to a bent or kinked piston rod. The remedy for this is to place the piston and piston rod between centers on a lathe and test it by running the lathe.

Any kinks or bends in the rod, or if the piston is not square on the rod, will be easily detected in this test. C. E. ANDERSON.

Suggestion About Suggestions

DON'T BE afraid to let your subordinates make suggestions. Instead, encourage them to make suggestions. It will do your plant, you, and your subordinates good.

Pay them for suggestions that are acceptable in the same way that engineering and technical papers pay for hints and kinks that are of value. And even if the suggestion is OLD—adapted from some other plant or from a publication—pay the suggesters just the same. Show them that you are anxious to advance.

The best way is to have suggestions made in writing, and at the end of every month or so post the best suggestions on your bulletin board.

This plan may not be, in fact, is not new; but I know of several instances where the method is in vogue in one form or another, and it is a good plan. It incites interest and makes for an ideal plant.

One thing to remember in initiating the method—be fair and impartial to all suggesters. N. G. NEAR.

Friction and Engine Economy

A QUESTION appears on page 983 of the issue of Oct. 1: "What parts of an engine must have the most attention to get the most economy out of the steam?"

It is answered by Mr. Wallace as follows: "Economy of an engine depends upon the manner in which the steam is handled by the valve or valves and their condition. It is an easy matter for the valves or piston to leak a quantity of steam at every stroke, which though small will in the long run amount to considerable fuel. It is also an easy matter to test out for leaks, which should be done frequently."

This answer has caused quite a lot of discussion among the engineers in this section. A large number lean toward Mr. Wallace's way of thinking. I think otherwise, not because I understand the steam engine better, but because I think there is much room for argument.

Not getting the most economy out of the steam is, in my opinion, anything which will increase the size of the diagram for a given load and speed.

Such men as Professors Ramsey, Spangler, James P. Rowe, H. A. Howe, and Geo. T. Gilbert tell us over their own names that by just changing the piston rod packing from a good to a bad packing increased the friction from 10 to 50 per cent, which I can very well believe, because I have seen a pump and engine brought to a stop by tightening up the gland nuts on the piston rod stuffing box, I have seen a shaft governor put out of commission by the same thing on the valve rod, and an eccentric slip on the shaft, the strap and rod break and the engine brought to a stop for the want of oil.

Friction is such a destroyer of economy that I cannot conceive of any valve setting or leaking piston that would waste as much as friction. Some people would hardly believe that the air brake on a train of cars is stronger than the locomotive; but such is the case, as it will take a locomotive a distance of half a mile to get a train of 6 cars going at the rate of 50 mi. an hr., and the brake can bring the same train to a dead stop within 1000 ft.

But I know Mr. Wallace can say something interesting on this subject. JOHN H. ARMSTRONG.

Economy for Steam Laundry

WE HAVE read with much interest the article on p. 1057 of the Nov. 1 issue, entitled, Economy for the Steam Laundry.

We heartily agree with the introductory statement, pointing out the difference between the expert services of laundry machinery manufacturers used in the equipment of a building as compared with the haphazard manner in which the power plant equipment is usually handled. We believe, however, this applies more particularly to laundries that have been in operation for some time, than to present-day laundry installations. That is to say, we believe that the laundry operator is taking a greater interest in, and therefore, paying more attention to his power plant from the standpoint of economy and operation, than he has in the past.

We take exception to that portion of the article referred to, which contains the statement, "Every steam laundry can therefore become a commercial power plant, and, producing power at a fraction of the usual cost, can sell it at a correspondingly large profit."

In recent years, we have developed a line of storage heaters especially designed for laundry service. Our observations in actual operation developed the fact that in the great majority of steam power laundries, the exhaust from the engine passed through the tubes of a storage type pressure heater, will heat all of the wash water required in the laundry to the desired temperature, and that there is little, if any, exhaust steam wasted. In other words, the relation between the exhaust steam resulting in the development of sufficient power to operate the laundry and the heat units required in furnishing a sufficient quantity of hot water, is that of practically a perfect balance—on the basis of 30 lb. of steam per horsepower per hour.

We place particular emphasis in the above statement on using a storage type heater, for the reason that it has also been demonstrated, where the exhaust passes through a coil in an open tank, it is invariably necessary to use live steam in the washers to bring the temperature of the water to the required point; we have known of laundries effecting a saving of from 1 to 2 tons of coal a day, by changing from the open tank to the pressure tank system. It will be readily appreciated, that by passing the exhaust steam through an oil extractor and gathering condensation from the heater with that from live steam heated machines into a common receiver from which it is pumped to the boiler as feed water, at a high temperature, a material saving in fuel will be the result and the laundry will be operating under the most economical conditions.

In addition to our objection to the suggestion that a power laundry can easily become an agent for selling power, we desire to point out, on the other hand, that it is a dead loss in operation for a laundry to purchase current for operating its machines, using a steam boiler for water heating and other purposes only; in other words, a laundry can furnish its own power practically for nothing with the same steam required for water heating purposes, making it independent of any outside source of power, a complete unit within itself.

As above stated, we believe that the power end of a laundry is being given more attention today than ever in the past, and we would like to see some of the points raised in this letter brought to the attention of that trade, in the general interest of economy.

THE SIMS CO., H. W. SIMS.

Lap of Steam Valves on a Corliss Engine

IN OCT. 15 ISSUE, I note Mr. Dixon's criticism of the answer given by Mr. Palmer to the question concerning changing the dashpot rod.

The remarks in this article concerning lap prompt the writer to submit a question, the discussion of which, brought out quite a difference of opinion among the members of our local association.

The question was put by the educational committee for the purpose of testing the ability of the members concerning the setting of the steam valves on a double eccentric Corliss engine. The question ran thus: How much lap would you give the steam valves on a 20 by 48-in. double eccentric Corliss engine?

Some answered ⅛ in., some ¼ in., and others said just enough to make the steam valve tight with the dashpot down. Others said the valves would have no lap at all.

Those who gave ⅛ in., ¼ in., etc., said the definition for lap, as given for a single eccentric engine, did not hold good in the case of a double eccentric, and the definition for lap in the latter case meant the amount the valve overlapped the port with the dashpot down. Others not familiar with the double eccentric scoffed at the idea of the steam valves being open when the wristplate was in the center of travel. Strange as it may seem, among the latter was a chief engineer in a large plant containing 4 double eccentric engines. He would not be convinced until he looked at the blueprints (which he happened to have) of the valve setting of these engines, which by the way revealed how well he was posted on the machines in his plant.

As the writer understands it, the definition for steam lap is, the amount the steam valve overlaps the port with the wristplate in the center of travel, the valve being hooked up.

It seems as if this does, or should hold good in the case of a double eccentric also. Of course, as is practically always the case, in a double eccentric engine, the steam valves are never lapped over the edge of the port, but actually stand open when the wristplate is in its center of travel. This opening is usually referred to as negative lap, meaning less than no lap at all, and varies according to the size of the engine and the position of the steam eccentric, being greater the nearer the eccentric is to the crank.

The writer would be pleased to have readers give the definition for lap as referred to the steam valves of a double eccentric Corliss engine. How many have ever seen the definition given by any textbook or other authority? JOS. STEWART.

Some Queer Piping

WHEN ONE is going around the country one will find or see some queer piping once in a while. Figure 1 shows how I found a small vertical engine piped for the cylinder cocks. Steam was blowing through into the exhaust. This engine was used for a generator when

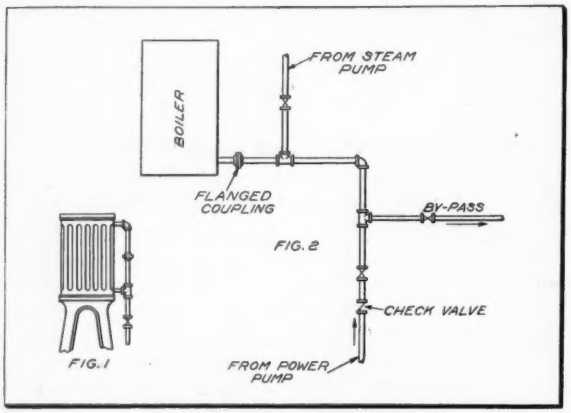


FIG. 1. PECULIAR CYLINDER COCK PIPING
FIG. 2. BAD BOILER FEED PIPING

the larger engine was down. Figure 2 shows some funny piping. Notice there is no valve between the boiler and flange in the feed line. Now, if the packing should happen to blow out, one would have to pull the fire, as it would draw the water out of the boiler. Also the bypass between the boiler and check valve would run the water out of the boiler if valves should happen to be left open.

One of these engineers had a chief engineer's license and did not know enough to set the valves on his engine, which was a Corliss type. No one else is to blame but the inspectors. A. L. JOHNSON.

IN NORTHERN MINNESOTA, there is a great area of land so flat that its waters sometimes flow into Hudson Bay and sometimes into the Gulf of Mexico. There are times when certain lakes discharge at both ends, the northern outlet carrying water through Red River or Rainy River to Lake Winnipeg and thence to Hudson Bay, while the southern outlet carries water to the Mississippi.

Answers to Minnesota Examination Questions

24. First get the pistons and plungers exactly in the center of the stroke. In this position, the spools should be in the center of the stroke and the arms plumb. If not, make them so. Then set the valves centrally over their ports and adjust the clearance between the nut on valve stem and the ears on the valves so that it is the same on both ends. One port should be uncovered before closing the chest so the piston will get steam.

25. Yes.

26. With a perfect vacuum, water can be lifted 33.9 ft.; but a pump is in good working condition to lift from 25 to 29 ft.

27. With a brass or steel boiler bushing in the front head above the tubes.

28. A feed water heater is a benefit because it raises the temperature of the feed water entering the boiler, thereby saving coal. An open heater also serves to separate some of the impurities from the water which leave it at temperatures under the temperature of the steam entering it. In addition to this, some have a grease extractor contained in them and a filter bed of coke, also a settling chamber. In this style, the steam is in contact with the water which is usually separated into small streams or films by pans or plates. The body is of cast iron and is provided with suitable clean-out doors. In the closed heater, the water and steam are separate, the thickness of the brass or copper tubes being between them. In some cases, the water is in the tubes and the steam surrounds them and others are vice versa. In the first instance the body is of cast iron and in the second of steel with hand-holes for cleaning. Both are provided with proper drains.

29. Steam issues from a nozzle and crossing a small gap enters another nozzle or tube called the combining tube. In doing so, it creates a partial vacuum in the body of the injector. When enough vacuum is formed, the water rises and enters the injector. The velocity given the water by the steam enables it to open the check valve and force itself into the boiler.

30. A steam engine is a device for changing the potential energy into mechanical energy.

31. The steam chest, which acts as a medium between the steam pipe and valve; the valve, which governs the distribution of steam in the cylinder; the cylinder inside of which the steam expands; the piston against which the steam expands and forces ahead; the piston rod, which transmits the power to the crosshead, acting as a guide for the piston and rod; the connecting rod, which changes the reciprocating motion to a rotary one by connecting the crosshead and crank; the crank, which gives the power to the shaft to revolve the flywheel and whatever other contrivances there might be; the flywheel which is a store house for energy and carries the engine over the center; the eccentric, which gives a reciprocating motion to the valve rod, which in turn actuates the valve. The shaft is supported by bearings resting on the foundation. Most stationary engines possess a governor of some descrip-

Continued from p. 1126, Nov. 15 issue.

tion actuated by centrifugal force and governing the speed of the engine by controlling the amount of steam entering the cylinder.

32. See whether the eccentric is ahead or behind the crank when the latter is on the center. If the valve and motion are both direct, the eccentric should be ahead; if either is indirect, it should be behind the crank; if both are indirect it should be ahead to make the engine run over.

33. An engine is running over when the upper rim of the wheel is turning away from the cylinder. It is turning under when the upper rim of the wheel is turning toward the cylinder.

34. If there is a rocker arm, first, by turning the eccentric around the shaft, see that it swings equally both sides of a plumb line, dropped through the center of its fulcrum. Then measure the lap on the valve and with the eccentric on the quarter, place the valve in its central position over the ports. Place the piston on the head end and turn the eccentric the way the engine is to run until the port on the head end is open the amount of lead you wish to have. Fasten the eccentric to the shaft, turn the engine to the crank-end center and if the lead is not the same, make it so by giving part on the eccentric and part on the valve stem. This will give equal lead but unequal cutoff. To get equal cutoff, the lead must be increased on the crank end.

35. Without removing the chest cover, it can be done with tram marks on the valve stem. Place the engine on the head end center and make a mark on the valve stem a measured distance from the stuffing box. Loosen the eccentric from the shaft and turn it the way the engine is to run until the mark on the valve stem comes back to where it previously was; then fasten the eccentric.

36. By a governor.

37. The centrifugal force of the balls throws them outward and, according to the design of the governor, either raises or lowers the spindle to which is fastened a balanced valve. This raising or lowering of the valve governs the pressure admitted to the valve chest.

38. (A) Yes. (B) Experience in the daily care to keep them in good working condition, adjusting speed and regulation.

39. The lifting of 33,000 lb. 1 ft. from the ground in 1 min., or any factors giving this product of 33,000 ft. lb. per min.

40. (PLAN) ÷ 33,000. P = mean effective pressure, L=length of stroke in feet, A is area of piston and N is number of strokes per minute.

41. Revolutions per minute.

42. Mean effective pressure.

43. Yes.

44. That the speed of the engine is governed by cutting off the steam in various points of the stroke, depending on the load, and that this cutting off is done by a part of the engine itself, the governor.

45. Yes.

46. The space between the head from which the piston will move, and the piston, when the engine is on center; also, the space occupied by the ports.

47. So that the piston has the full benefit of the pressure at the beginning of the stroke.

48. If a new engine, place the cylinder on its foundation and level it. Run a line through the cylinder and out beyond the crankpin. Fasten this line at both ends, after drawing tight so there is no chance of its slipping, yet so it can be moved very small amounts without unfastening. With a pair of calipers or tram, center this line from the counterbore on the head end and the hole for the piston rod on the crank end. If the cylinder is set correctly and the line adjusted properly, you will find the latter perfectly level. Run a line at right angles from this first line where the shaft will set. It must be arranged for moving the same as the first. Be sure that it is perfectly level and at exactly right angles; then, with the boxes and caps in place, adjust the bearings so that the center of the shaft when placed will correspond with the present position of the line. After placing the shaft, test its alinement by turning the crank from one center to the other with the cylinder-line in position. If it is at right angles the line should cross the crankpin at both ends equal distances from the crank disc. A level placed on the shaft will give its position horizontally. In the case of the guides they should be perfectly level and both top and bottom equal distances from the line at both ends.

49. With an engine set up and a line placed through the cylinder, centered at the crank end, horizontally perfect with the center line of the shaft and level it is found that the line cannot be centered at the head end, leaving the rest unchanged, that end should be raised by placing wedges under the base and driving them until the head end is in its proper place.

50. A device for feeding oil automatically into the cylinder of an engine. Their operation is based upon the difference in weight of oil and water. The condensed steam or water entering buoys the oil. Inside the lubricator is a small tube open at the top and leading to the regulating valve or discharge. The oil, being at the top, is forced into this tube, through the regulating valve and into a gage glass connected with the steam pipe. Rising through the water, the oil is carried away with the steam to the cylinder.

GEO. B. LONGSTREET.

Single Eccentric Corliss Valve Gear

ON PAGE 985 of the Oct. 1 issue, Mr. Palmer, in answering question No. 28, does not make the matter clear. Not that I wish to find fault with the facts as stated; but I believe that his statement will tend to confuse the reader unless it is clearer why cutoff is limited in this way.

His statement is as follows: "With valves properly set, the engine to run over, the crank on the head end center, and the head end steam valve open for lead, the eccentric will be ahead of the crank 90 deg. plus the lap of the steam valves and the lead.

Sure it will, with a few if's and and's. If by "sum" is meant algebraic sum, and if lap may be called either + or —; that is, if negative lap is clearance, then this statement is true. Still, it is confusing, because it would appear from reading this that the position of the eccentric is determined by the lap of the steam valves; whereas, the lap in a Corliss valve gear

is determined by an adjustable radius rod, and the position of the eccentric is determined by the exhaust valves.

A moment's consideration will show that this is so. During exhaust, that is from release to compression, the exhaust valve is open; the remainder of the stroke the valve is closed. Since release takes place just before the crank reaches one center and compression just before the other, and since from the facts stated above, the opening and closing must be about half stroke of the valve, it follows that the eccentric and crank must be about 90 deg. apart.

As far as the steam valve is concerned, the position of the eccentric is a matter of indifference, the only limitation being that it be far enough ahead of the crank so that we can get the lead; therefore, the double eccentric engine.

From the above mentioned facts, it is often stated that the limit of cutoff of a single eccentric engine is "about half stroke." Cutoff, however, may be considerably later than half stroke, as the following consideration will show: cutoff occurs when the valve closes, not when the latch releases. The latch will strike the block "about half stroke," then consider what occurs. The upward motion is arrested and the valve and connected mechanism must accelerate in a reverse direction, until passing the point of closure, the dashpot piston seats on air cushion. The accelerating force is partly gravity and mostly atmospheric pressure due to the vacuum in the dashpot. Meanwhile, the piston has not been idle. It is at mid stroke, hence moving with its highest velocity.

Let us now come down to figures as to the actual facts. Nowhere can I find anything written about the time it takes a dashpot to close a valve. We will therefore make an estimate and the readers of Practical Engineer can criticize it and probably improve upon it. The actual speed could be measured on some engines where the indicator motion can be passed around to the valve side. A pencil attached to the dashpot rod or jim crank with the indicator as a chronograph would give the exact time of fall of dashpot rod in terms of piston travel. But the indicator drum must be pulled by the indicator motion, as, if it is attached to valve motion, or oiler, the results will not be in terms of piston travel, hence will be of no use.

To begin with, we will assume a piston speed of 600 ft. per min. This is, of course, the average speed, as twice each revolution the piston is at rest and at no time is the speed uniform; it is either accelerating or retarding. Reducing the time to seconds, 600 ft. per min. is 10 ft. per sec.

The crankpin, however, travels at a uniform speed and moves the circumference while the piston travels 2 diameters. The travel of the pin is, therefore, 3.1416 ÷ 2 times the travel of the piston, or a little over 15 ft. per sec. Since the speed of the pin is uniform, the velocity is the same as the space per second; that is, 15 ft. Neglecting the angularity of the connecting rod, the velocity of the pin at half stroke is the same as that of the piston; therefore, we may estimate the piston velocity at cutoff as about 15 ft. per sec.

To estimate the acceleration of the valve, that I spoke of above as being unable to find given anywhere, the following experiment was tried. A cube of babbit metal was laid on the plunger of the dashpot as it rose and fell to note if the fall was faster than a falling body. The rise was about 2 in. and the plunger seated about ⅜ in. ahead of the falling babbit. Some of this might have been due to the valve tossing the cube slightly. It was found that by placing the finger on the piece, it could be held in contact with the plunger by a slight pressure considerably less than the weight of the cube.

This is an exceedingly rough estimate; but it is presented here as there is nothing better to offer, as far as the writer knows. From this experiment, it was concluded that the acceleration of the dashpot was only slightly in excess of the acceleration due to gravity. This, of course, is not true in every particular case, but is assumed for the purpose of arriving at some result. The fact is, however, that an error in this assumption enters only as a square root and it would have to be very wide of the mark to be a serious error.

The acceleration due to gravity is a little over 32 ft. per sec. or over 384 in. per sec. If we allow the dashpot acceleration at 600 in. per sec., it would seem to be enough to fit the case.

The equation for accelerated motion is,

$S = \frac{1}{2}\, a\, t^2$.

S = space passed over.

a = acceleration.

t = time.

Our units are, space in inches, acceleration in inches per second, time in seconds.

To find time, we transpose.

$$t = \sqrt{\frac{2S}{a}}$$

If we allow 1½ in. for travel to close valve, we have S = 1½. Substituting in the equation,

$$t = \sqrt{\frac{2 \times 1\frac{1}{2}}{600}} = \sqrt{\frac{3}{600}} = \sqrt{\frac{1}{200}} = \frac{1}{14.1}$$

= 0.071 sec.

While the valve is closing, the piston is moving at its highest velocity or about 15 ft. per sec. as explained above.

15 ft. = 180 in., therefore the distance moved by the piston is 180 × 0.071, or 12.8 in., say 13 in.

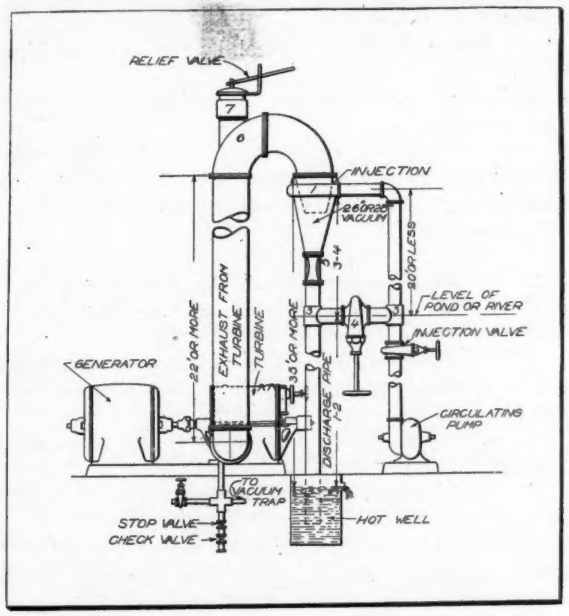
Suppose now that the length of the stroke is 60 in. Suppose we can set the gear so that the latch will strike 27 in. from the beginning of the stroke; the valve will not close until the piston has moved 13 in. farther, that is, at 40 in. from the head. Therefore, cutoff will take place ⅔ stroke instead of ½ stroke, as usually stated.

The writer is sorry to have to close this without some good cards to prove his contention. This is due to a limited experience with the single eccentric type. All the engines where the load could be varied at will; i.e., those driving generators, have been double eccentrics. The only single eccentric 4-valve engine was belted to a factory and the load never caused a cutoff of later than ⅓ stroke. Besides, the engine ran pretty slow. An attempt to lengthen the cutoff by throttling was a failure, as the wire-drawing made the actual point of cutoff uncertain. Therefore, I can not prove my assertion; but I fully believe that with a good piston speed and a reasonable dashpot travel, it will be possible to get a cutoff as late as ⅔ stroke with a single eccentric engine. If not, please correct me. IRVING W. BOOTH.

A Simple Condenser Connection

WITH REFERENCE to Receiver's article on The Barometric Condenser in the Nov. 1 issue, it might be of interest to show in addition, how steam turbines are nowadays connected. I show here a turbine connected directly to the piping illustrated in Receiver's article.

It can well be imagined that a barometric condenser will do its best work and can be installed at minimum cost where the exhaust piping is short and simple. Piping away from the top, as shown, is therefore a decided advantage. One short pipe, one bend, and direct connection with the condenser is obviously better than the 2 pipes and 3 bends necessary where the exhaust is taken from the bottom of the turbine.



BAROMETRIC CONDENSER CONNECTED TO TURBINE

I know of no simpler condenser arrangement than this. N. G. NEAR.

Refrigeration Capacity

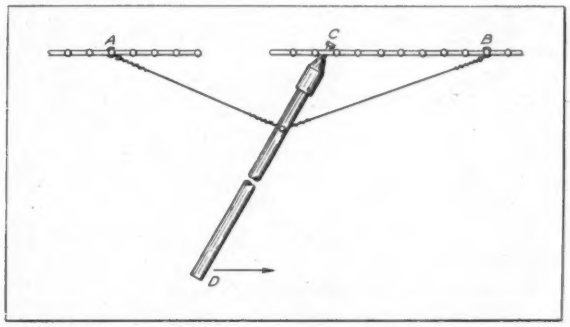
IN REFERENCE to Mr. Spooner's article, if lowering condenser pressure from 190 lb. to 170 lb. will increase pressure, why not lower to 150 lb. or even 100 lb.? I am afraid this does not always work out in practice in all cases. In my own plant, which is a direct expansion cooling plant with numerous lengths of expansion piping, if the pressure is low, we do not get the required amount of ammonia in the coils to frost all the pipes. We cannot alter the speed of the compressor, so I carry high pressure, 180 lb., and 15 lb. back pressure. In this way, we cool down the room to 62 deg. F., with outside temperature 86 deg., in 1 hr.; while, with pressure of 100 lb., it takes 4 hr.

Again, if in some horizontal, double-acting machines, a gasket was put under the cylinder head to increase clearance, the suction and discharge lines could not be connected, so this might mislead. I have run wet on a dry compression machine, but not for long, as the saturated ammonia came over in slugs and every little while the machine, which ran at 130 r.p.m., came nearly to a standstill with a groan you could hear all over the building; so I thought about "Safety First" and stopped.

J. S. BELL.

Tool for Removing and Replacing Link Belt

ACCOMPANYING is a sketch of a tool I use for putting on and removing link belting Nos. 35, 45 and 55. The handle consists of a piece of 1¼-in. pipe with a reducing coupling into which is inserted a bolt, thread cut with a pipe die. The head is filed down to allow the chain to pass over nicely. About 9 in. from this end, a hole is drilled and pipe cut away to allow a pin to be inserted on which wire leading to hooks is wound. The idea, while not original, is a good one and will be appreciated by anyone accustomed to removing and replacing link belt.



TOOL FOR APPLYING LINK BELT AND SPROCKET CHAIN

To apply, insert hooks A, B and bolt C into chain as shown. By moving handle D in direction as indicated by the arrow, hook B becomes slack and is shifted one or more links, as desired. By removing chain from bolt C, handle D is brought back to original position and the operation is repeated until the chain is sufficiently tight to connect. S. G.

Unique Accident to Small Turbine

RECENTLY THE writer saw the results of a peculiar accident to a small impulse turbine of 15 hp., which had been in use about 3 yr.

At the time of the accident, the machine was being run by a stranger, who apparently had allowed the turbine spindle bearings to become short of oil, consequently they wore, and to help matters someone started up a motor which was really too large to be driven by the turbine, with the effect that the sudden load plus worn bearings caused the small turbine gear to jump out of mesh, with the results that the generator stopped and the pinion or turbine spindle milled a groove straight across the gear wheels. This is the first time the writer has ever seen this happen to a geared turbine of this type. Obviously, the only thing to be done was to fit new gears. E. R. PEARCE.

THE prevention of accidents and injuries, by all possible means, is a personal duty which every man owes, not to himself alone, but also to his fellow men. The use of a sign or a word of warning will burden nobody and may save a life.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Boiler and Pump Questions

FOLLOWING is a list of questions and answers constituting an Ohio examination for a third class engineer's license.

1. How could you tell if the blowoff pipe on a boiler was broken?

2. If there was only a small leak in the blowoff pipe and the water did not lower in the glass perceptibly, how could you discover it?

3. Suppose there was so much noise you could not hear the steam or water escaping in the blowoff, how could you tell there was a leak?

4. Suppose your check valve was broken and could not be fixed, and you did not have a spare one, what would you do?

5. Would you shut down on account of the check valve being broken?

6. What is a single-acting pump?

7. How many sets of valves has a single, and how many sets has a double-acting pump?

8. What is the difference in appearance of the 2 pumps?

9. What and where is the follower plate on a pump?

10. Where would the water level show if you shut off the lower connection of the water glass?

11. Where would the water level show if you closed the top connection of the water glass?

12. If you had a battery of 6 boilers and the blowoff pipe broke on one, what would you do?

13. How many compartments has the duplex pump?

14. If your safety valve is set at 100 lb., and you came into the boiler room and found the gage read 150 lb., what would you do?

15. Can a single-acting pump be made to work double-acting?

16. Where is the dry-sheet on a boiler?

17. What is the difference between a flush and an overhanging front?

18. If the end of your blowoff runs into a tank, how can you tell where a leak may be?

19. Where is a fusible plug and why can you not put it in the front?

20. Does the water travel faster in the water glass when you shut the top or the bottom connection?

21. If the water is at the second gage or more, in the glass, and you get steam from the second try-cock, what is the trouble?

22. Explain the way the water travels through a duplex pump; also through a Hancock inspirator.

A. If the blowoff pipe breaks outside the boiler, the room will become filled with steam and water; while, if it breaks inside the boiler, the fire doors will probably be thrown open and the ashes and fire blown out.

2. You could discover a leak by feeling of the blowoff pipe; it would be hot.

3. In the same manner, by feeling of the pipe to see if it was hot.

4. Continue to feed the boiler through the broken check until you can shut down and obtain another, or shut the stop valve and take out the broken check if you cannot run as it is.

5. No; not unless absolutely necessary.

6. A single-acting pump is one having one set of receiving valves and one set of discharge valves, and delivers but once for every 2 strokes.

7. A double-acting pump has 2 sets of receiving and 2 sets of discharge valves, while a single-acting pump has but one set of each.

8. The pumps may be similar in appearance, although usually they are not.

9. The follower plate on a pump is a plate screwed onto the plunger to keep the packing in place.

10. If you shut off the bottom connection the water would slowly rise to the top of the glass, due to the condensation of the steam therein.

11. If you close the top connection, the water will rapidly rise to the top of the glass.

12. If you had a broken blowoff on one of a battery of 6 boilers, the only thing to do if at all possible is to open the fire doors, although the probabilities are that they will be blown open. If you can, it would be proper to close the ash pit doors and open the fire doors and flue doors, bank fires and disconnect boiler from the main header; then make repairs.

13. The duplex pump has one suction compartment, 4 compartments above the suction valves and one above the discharge valves.

14. The safety valve may be stuck or the gage may be out of order. It would be best to lower steam pressure and try the safety valve.

15. No: a single-acting pump must have 2 suction valves and 2 discharge valves to work double-acting.

16. The dry sheet on a boiler is between the front head and the tube sheet.

17. A flush-front boiler is built flush with the brick work on the front end and an overhanging front boiler overlaps the brickwork the width of the dry-sheet.

18. If the blowoff pipe leaks the pipe will be hot and you can feel of it and discover the fact, even if it enters a tank and the end is concealed.

19. The boiler usually pitches about ½ in. in every 10 ft., and if the fusible plug is placed in the back part of the boiler the plug will be under water when the water level in front is really below it.

20. The water will flow faster if you close the top connections, due to the pressure in the boiler.

21. If you get steam at the second try-cock and the water in the glass is above that point, then you may have a leak in the top stuffing box or the glass or the top may be stopped up or possibly the bottom of the glass is stopped up and the steam condensing in the top of the glass has caused the water to rise in the glass. The water in the boiler may be foaming.

22. (a) In a duplex pump the water enters the suction pipe, and fills the lower compartment under suction valves, is drawn up through the suction valves into the piston chamber. As the piston reverses the water is forced through the discharge valves, and out. The suction valves close as the piston reverses its stroke. The pump draws water at one end, and discharges it at the other, at the same time. The other piston does the same thing except that it travels in an opposite direction.

(b) The water goes up the suction pipe when the steam is turned on and a vacuum is formed. It enters the nozzle on the starting side and is forced through the inspirator over to the forcing side, through the bottom passage. When the water reaches the forcing side, it enters the inside pipe through the top overflow valve and goes to the overflow. The top overflow valve is then closed and the water rises until it goes into the nozzle on the forcing side. The forcer is then opened and a second jet of steam enters the nozzle on the forcing side through the top passage. The stop valve to the boiler is then opened, the bottom overflow valve is closed and the water is then forced into the boiler.

LUKE MARIER.

Massachussetts Examination Questions

Q. WHAT IS the counterbore of an engine?

2. How would you center the piston of an engine?

3. When placing shims in crank or wristpin boxes, where should they be placed?

4. Why are wooden or asbestos plugs used in hollow staybolts?

5. I maintained that in setting the eccentric on an improved Greene engine, it should be placed just behind the crank in order to give admission. Am I not right in this? A. A. H.

A. In removing the cylinder head from the cylinder you will notice a rim about 1 in. wide with a little larger diameter than the actual cylinder bore. This is called the counterbore of the cylinder and serves as a sort of guide in case the cylinder has to be rebored after being in service for some time. By this counterbore the workman can tell just where the cylinder is worn most and can then rebore accordingly. The piston also overtravels the bore into the counterbore, thus preventing a shoulder at each end.

2. To center a built-up piston of an engine with the crosshead, first center the piston in the cylinder by the junk ring, and then measure the distance of the piston rod center from the lower guide. The crosshead shoe should then be adjusted until the center of the crosshead is at the same distance from the lower guide, when the piston rod may be connected to the crosshead.

3. In regard to placing shims in crankpin or wristpin boxes, it all depends on the type of connecting rod you have, and how you wish to adjust it. For instance, on a Corliss engine, if the cap screws which control the wedges were both on the outside of the boxes, so that the wedges forced the bearings from each end toward the center of the rod, then, in order to keep the rod the same length when taking up wear, it would be necessary to place the shims on the inside of the boxes.

If, on the other hand, both cap screws were on the inside of the boxes, so that the wedges forced both boxes toward the ends of the rod, the wear would tend to lengthen the rod, so in order to shorten up, the shims must be placed outside the boxes. Of course, if you wish to lengthen the rod, you place the shims on the inside.

Some rods are made with one adjusting wedge on the inside and the other on the outside. This type is not likely to need shims when taking up wear, for the bearings will wear about evenly.

4. Hollow staybolts are usually used on water legs of locomotive type boilers, and the air passing through the hollow tends to keep them cool and helps supply oxygen for the fire. If too much air is supplied, they might be plugged; or if a bolt was cracked so that it leaked.

5. In regard to setting the eccentric on a Greene engine, you are partly right in your statement. The eccentric is placed behind the crank; but it is placed somewhere between 90 deg. and 180 deg., so as to give about 1/16 in. lead opening to each steam valve when the engine is on dead center. I refer you to an article on Greene Engine Valve Motion, which appeared in June 1, 1912, issue of Practical Engineer. R. E. T.

Engine Trouble

I HAVE a 7 by 8-in. slide valve engine that pounds badly. The diagrams from this engine show that the terminal pressure runs as high as the compression. I can not alter this high terminal pressure unless I advance the eccentric. This causes earlier opening of the steam ports.

The engine in question has practically no load. How would it do to add a 1/8-in. strip to the outer edge of the valve; then advance the eccentric for earlier opening and closing of exhaust? Or should I also add a strip to the inner sides of the valve? W. D.

A. We would not dare to estimate the result of adding lap to your valve without seeing an indicator diagram from it. If the engine is pounding because of high speed and insufficient compression, advancing the eccentric will lower the terminal pressure and increase the compression pressure, and even if the steam ports are opened earlier, it is not likely that this will do any particular harm. The advance should not be very great.

Putting on a 1/8-in. strip in the dark is entirely guesswork, and we would not like to try to estimate what the result would be. A. L. R.

Draft Pressure in Inches of Water

IN DETERMINING draft pressure, please explain just what is meant by "inches of water."

Explain the following rule:—Divide 7.6 by the absolute temperature of the cold air; divide 7.9 by the absolute temperature of the hot gases; subtract the latter quotient from the former and multiply the remainder by the height of the chimney in feet. The result will be the draft in inches of water. G. O. M.

A. In regard to the matter of draft pressure, this is generally measured in inches of water, which means the difference in level which will be produced in a U-tube partly filled with water and attached to the draft chamber.

Of course, when there is no draft, the water will stand at the same level in the 2 legs of the U-tube; but when draft is present, the water will rise in the end connected to the draft chamber and fall in the other end. As a matter of fact, it is found that one inch of water draft equals a pressure of about 5.2 lb. per sq. ft.

In regard to the formula which you mention, this has a basis in scientific fact, but is modified to conform to actual practice as found. The draft at the base of a stack is determined by the difference in weight between a column of air outside the stack and inside. The difference in pressure per square foot inside and outside the stack will be the density, or weight per cubic foot at atmospheric temperature, minus the density at stack temperature, times the height of the stack. This would give the difference in pressure between the inside and outside, or the draft pressure in pounds per square foot.

As already stated, one inch water gage is equal to 5.2 per sq. ft., so that dividing this draft pressure as expressed in pounds per square foot by 5.2, gives the pressure in inches of water.

The weight of a cubic foot of air varies inversely as the absolute temperature, and at 32 deg. F., which is 492 deg. absolute, the weight is 0.0807. To find the weight at any other temperature, multiply this weight by 492 and divide by the temperature absolute. This would convert our formula to; pressure in inches of water equals $0.0807 \times 492 \div 5.2 \times$ the height of the chimney in feet, and this multiplied by the difference between $1 \div$ atmospheric temperature absolute and $1 \div$ stack temperature absolute.

As a matter of fact, it is found that this equation does not quite represent conditions maintained in a chimney, partly because of the cooling off of the gases as they rise, partly because of the friction inside the stack, so that the formula is changed to that which you have sent.

The theoretical formula would give 7.64 as the numerator in each of the terms, and the change to 7.6 in the first term, and 7.9 in the last term is to make the equation conform to facts as found. A. L. R.

Heating Problem

IN THE plant of which I am in charge, we have what might be called a double system of hot blast heating, that is, there are 2 stacks of heating coils, 2 fans and 2 engines located in 2 different buildings.

One building is occupied by a firm to which we furnish power, heat and light. The return from the heat is metered so that it must be handled separately from the rest. In this installation are approximately 4000 sq. ft. of radiating surface.

In our shop we have a similar, but smaller, installation of about 3000 sq. ft. of radiating surface, making a total of about 7000 sq. ft.

We use exhaust steam in heating, but do not have enough, so have to employ some live steam, making it a rather expensive proposition.

I have been thinking of changing this and making it a vacuum system; but this would be expensive, because the office heating in both shops would have to be changed and made into a 2-pipe system. We are carrying from 2 to 5 lb. back pressure at present.

Could I make any saving by changing to a vacuum system? How could this saving be figured out?

I have about 1100 ft. of piping about the plant, which is uncovered and at least half of this carries live steam. Now, I figure that I can save at least $250 a year by having this pipe covered, and may perhaps be able to make the exhaust do the heating throughout the day without the use of live steam. It seems to me this would be the thing to do; but I have been advised to go ahead and put in the vacuum system, although I would like other opinions on the matter before changing.

I have a Corliss engine, 18 by 42 in., running 87 r.p.m., doing an average of 75 hp., boiler pressure 85 lb. Should this furnish exhaust steam enough to do the heating? E. C. G.

A. It is difficult to determine the amount of steam that would be saved by changing over your heating, as you suggest, into a vacuum system. In cold weather, when you do not have enough exhaust steam to heat the buildings, you would not benefit by the change; but in the spring and fall, there would be some benefit due to being able to run a lower back pressure on the engine. If you do not pump the returns back into the boiler in either case, the vacuum system would show up best, because the returns would be cooler, thus you would throw away less heat; but if the returns are pumped back into the boiler, you would not save by using the vacuum system.

In the spring and fall, when the exhaust is sufficient for heating the buildings, the vacuum system would enable you to run a low back pressure on the engine and thus effect some saving. A small air pump piped to exhaust the air from the coils through the air valve would be an inexpensive arrangement and might be a benefit.

It is always a safe guess that covering on high pressure pipes will pay for itself, and in most cases a good dividend. Of course, where the high-pressure pipes are in rooms which have to be heated, the heat from them is not lost.

The loss from bare pipes would be approximately 400 B.t.u. per sq. ft. of surface per hr., which equals a little less than ½ lb. of steam condensed, and the loss from covered pipes would not be over ¼ as much, or about ⅛ lb. of steam per hr. Now, if you know how many pounds of water your boiler will evaporate per pound of coal, you can soon calculate the cost of coal that is wasted from the uncovered pipes.

In order to calculate the amount of steam necessary to heat the building, it would be necessary to know the dimensions of the building, number of windows and size, and amount of air used for ventilation. In general, we know that 1 sq. ft. of direct radiation will condense about ¼ lb. of steam per hr.; but with indirect radiation where a fan is used, the heat loss from the pipes and consequently the condensation in the pipes is more, being proportional to the velocity of air across the pipes.

However, we can assume ½ lb. of steam condensed per sq. ft. per hr., which is a fair figure, which, multi-

plied by the number of square feet of radiation (7000) gives us 3500 lb. of steam per hr. needed.

Your engine probably does not consume more than 30 lb. per hr. per hp., and that multipled by 75 gives us 2250 lb. of steam as exhaust, so that there is not enough exhaust to fill the coils and heat the buildings.

S. E. BALCOM.

Electrical Questions

THERE IS in use in some plants a system of synchronizing alternators that is simple and gradually being brought more into use in other plants. The principle is that of throwing a single phase of the incoming machine onto the busbars. A sufficient reactance is inserted in series of this phase to choke down the rush of current. The machine is quickly drawn into step without jar and the main oil-switch closed and the double-pole oil-switch controlling this single phase with the reactance is cut out until used again for synchronizing. This is figured on a polyphase 2300-v. generator.

What I would like is a formula for figuring the amount and size of wire to be used in winding these reactance coils for any size generator at any voltage. I presume it will make some difference in the size of the machines and the voltage, but would like as full particulars as possible.

P. S.—Can 2 ordinary single-phase transformers be used to change from 2 phase to 3 phase on the "Scott" principle? C. D.

A. It is not possible to give a formula for designing a reactance to fit all generators for current limiting purposes in such a case as you describe. The design of the generator itself may vary to a large degree, and the conditions of use may be so radically different that to attempt to embody in a formula the various factors entering into the problem is useless.

"Floating in" an alternator without the use of synchronizing devices is not a new method of paralleling. The ordinary starting of synchronous motors (on the induction motor plan) is an example which is very common. The motor by virtue of the currents flowing through its stator, and the induced currents in the rotor mass, pulls itself into phase with the driving current.

In a generator, if the machine is up to speed, little effort is required to compel the rotor to assume the proper position,—a small torque sufficing to pull machine into step. Depending somewhat on the design of the machine, the problem becomes one of limiting the current flow to a value which will not disturb the system. This value is variable, for naturally a large generating capacity would not be much affected by a comparatively high current flow,—a flow which to a smaller plant might prove troublesome.

I am not familiar with your particular method of using a single phase to synchronize. It would seem that using all 3 phases would be more reasonable; first, because there would be no unbalancing of the system and second, because the incoming machine would have more synchronizing power.

Again,—it does not seem reasonable to excite a machine to normal voltage before closing the switch. The probabilities in favor of a large flow of current would be much greater under these conditions, as the machines might be in opposition, in which case one would have double normal voltage impressed on a circuit of comparatively low impedance. Then, the instantaneous starting value of current under such a condition would be much higher than the normal short-circuit current. From these considerations, it would appear that the logical method of procedure would be to close the oil switches first,—and then close the field switch. This would give the alternator opportunity to pull itself into step by induction motor action, and would also eliminate the sudden rush of current, which would follow a closure of switch at 180 deg. displacement.

Assuming the latter method to be used,—that is, closing the switch on unexcited alternator running at normal speed,—with no reactance in circuit at all, the flow of the current would be so limited by local impedance in the generator windings that (allowing for extreme cases) little disturbance would be caused. The problem then becomes one of designing a reactance to supplement the internal reactance to a degree sufficient to reduce flow of current to, say ¼ normal load current.

First of all, one would have to determine the impedance of the alternator to which the reactance is to be applied. This is done by running a synchronous impedance curve,—or, as it is commonly termed, a short circuit curve. It we are to use ¼ normal load current for our maximum starting current, determine by experiment what field current is required to force ¼ normal load through the short-circuited generator windings. Determine then what open-circuit voltage this will produce. Call this O V. Then our reactance must be of such size as to produce a drop of (normal voltage—O V) = R V, reactance voltage, when ¼ normal load current flows through it. Or, the impedance, J, must be 4 x R V x C ohms (obtained from J = volts ÷ amp. = (R V) ÷ ¼ C. The wire must be of a size to carry ¼ the normal current for a short time without overheating, say one circular mil for every 2 amp. The simplest way to determine the number of turns required is by experiment.

If you have available a transformer core (from a transformer rated at, say, 1/5 or 1/7 of your generator capacity) determine your drop per 10 turns with ¼ current flowing, and then using this as a basis, calculate by plain proportion the number of turns required for R V volts drop.

It is likely that the manufacturer of your generator can supply you with sufficient information to save you the work of making the short circuit test.

Two ordinary single-phase transformers may be used with a T connection for 2-phase 3-phase transformation. There will, however, be some unbalancing of voltages unless one of your transformers has an 86 per cent tap brought out. I have, however, used similar transformers and operated 2-phase 3-phase without any apparent trouble. V. E. J.

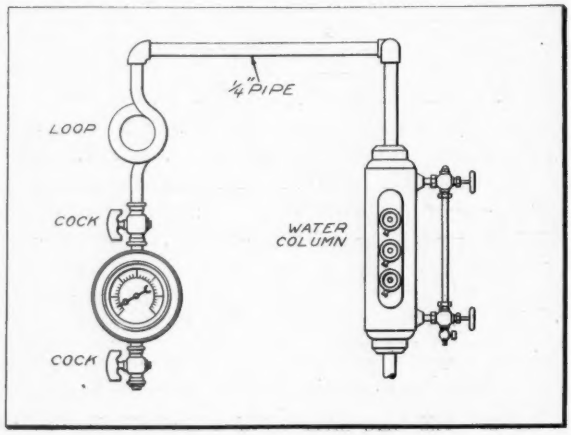
INTERESTING EXPERIMENTS by Prof. Onnes prove that at a temperature of 2 deg. absolute (about 489 deg. below zero) the resistance of metals to electric current becomes negligible. Current set up by induction in a ring of lead wire showed, after the removal of the inducing force, a decrease of only 1 per cent an hour, while at ordinary temperatures the current died out almost immediately.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

What Is Wrong?

ABOUT THE diagram of the heating boiler, entitled, What is Wrong? in the Oct. 15 issue, page 1041, it is customary in Massachusetts to provide a steam gage with a loop or siphon attachment to make sure the gage tube is filled with water. I see the diagram shows a condenser instead.



PROPER MANNER OF CONNECTING GAGES

Again, in piping up a steam gage, it nearly always has or should have 2 tee or lever handled cocks, one at the top for shutting off the steam if a gage should have to be removed, and one at the bottom for attaching the inspector's gage, as shown by the diagram.

LE ROY BLAKE.

I DO NOT think that the writers of letters in the Nov. 15 issue have discovered the 2 errors which T. G. intends the picture to show.

A pressure not exceeding 15 lb. per sq. in. is allowable on these Ideal cast-iron sectional heating boilers. With a valve between the boiler and damper regulator, the regulator will keep the damper wide open when the valve is closed. This is one error which was discovered and mentioned by W. T. Meinzer; but no one seems to have noticed that there are 2 reducers or bushings between the boiler and safety valve, presumably of common cast-iron construction and easily broken. If the original hole in the boiler for the accommodation of the safety valve is the proper size, then the safety valve installed on the boiler is 2 pipe sizes too small, or if the valve is the proper size then the hole in the boiler is 2 pipe sizes too large. Sometimes these boilers are enlarged by the addition of more sections, and no doubt the bushings would then be removed and a larger valve put in.

Whenever we see bushings between a safety-valve and the boiler, we jump to the conclusion that the valve is too small for the boiler. This may not be the case, as the hole in the boiler could easily be made too large or be enlarged through stripping the threads in the hole, thus necessitating the cutting of the next larger size of threads and the use of a bushing. As bushings (especially cast-iron) are very unreliable and an element of weakness, they should not be used. The hole, if too large, should be threaded and filled with a solid plug and a new hole of the correct size should be made.

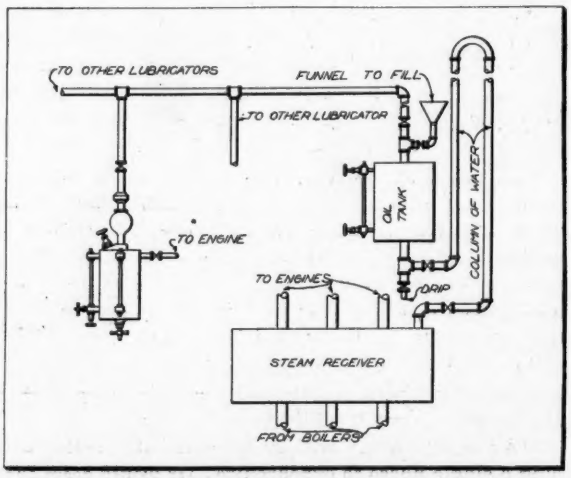
The connection taken from the pipe under the steam gage is required by the Massachusetts law and provides a place where the inspector is required to attach his test gage when checking up and comparing the accuracy of the steam gage on the boiler.

The damper regulator mentioned by W. T. Meinzer does not connect to the fire-door, but to the damper lever.

JOHN H. LINTON.

Oiling System Difficulty

IN REPLY to W. F.'s inquiry, I have had the same trouble. In his sketch the pipes marked A and C are not necessary. The pipe B supplies the lubricator with oil from the oil tank.



MR. MERRILL'S ARRANGEMENT OF OILING SYSTEM

The connection between the receiver and the oil tank is not correct, as the pipe should run up 5 or 6 ft. above the level of the lubricator and then return to the bottom of the oil tank, thus making a column of water to overbalance the pressure on the oil in the tank.

I think the accompanying sketch will make every detail of the system clear. M. MERRILL.

I WOULD make the following suggestion in regard to W. F.'s trouble. He should lower his feed tank, so that the top of it is at least level with the bottom of the receiver; it would, of course, be better to have it still lower if possible, but even this much I think would remedy his trouble. From his diagram, I presume he expects his feed tank to work on the same principle as the lubricator; namely, that the accumulation of water, under pressure, will force the oil out at the top, and according to the connections, as shown in the diagram, there is no possible chance for the water to accumulate in the bottom of this tank. As I understand it there is nothing but steam supposed to be in the receiver, and as there is no pocket to hold any condensation, it would be folly to expect the tank to fill with water. I would make the connection to the receiver on the under side, so as to accumulate condensation more rapidly. Of course, there is one objection to this, the accumulation of sediment, or dirt; but as this tank is blown out each time it is filled, I do not think that he would have any trouble from that source. E. C. S.

Cause of Wear on Cylinder

THE REASONS why an engine cylinder will wear on the top, are several and W. J. M.'s trouble, noted in the Oct. 15 issue, may be caused by any one or several of them. The writer has encountered a 13-in. cylinder which had a "pocket" possibly $^1/_{32}$ in. deep, 6 in. from the front end, and about 45 deg. from the vertical to the left, as you face the shaft from the cylinder.

At the rear end (head) was another similar pocket, the same distance from the head, and about 45 deg. from the vertical, to the right—diagonally opposite to each other.

The boilers foamed and primed badly here (so much at times as to cause one of the old engines which was so situated as to receive most of the slugs, to slow down considerably) that we laid it to this and a very late admission. The steam pressure was high (145 lb.) on account of an overloaded compressor, while the day electrical load was light with the result that the cutoff took place at about 6 to 8 per cent of the stroke.

As the steam packing ring in the piston was worn badly, and getting worse, the momentary shot of high steam pressure got under it and pressed it against the cylinder walls. In reboring the cylinder, it was noticed that where the pockets were, the metal seemed to be softer; although the reason for this could not be explained, as the cylinders were cast from a steel mixture supposed to be uniform throughout.

This experience is mentioned more in detail than the others as a possible solution to the trouble.

While no engine builder who has any pride in his product will be so lax in his methods, sometimes it will be found that the front head is not a tight concentric fit in the cylinder, and if care is not used in lining up on the job, it is easy to throw the front head out of line; if this error happens to be toward the top of the cylinder (especially on small Corliss engines, as will be explained later) this will cause the wear to take place on the top of the cylinder.

Manufacturers use possibly 6 different sizes of frames for standard engines for general use. For instance, a given sized frame will be used for, say, 12, 14 and 16-in. cylinders, but the bore of the slide will be the same size for all; that is, the slide for a 16-in. cylinder will be bored 16 in., and the slide for a 12-in. cylinder will be bored 16 in. also.

You can readily see that for a small engine, the weight of the large crosshead is greater than the weight of the piston head itself, and any error in alinement, or snug fit of the shoes in the slide, will tend to make the piston "track" with the heavier crosshead.

No matter how much skill is used in fitting the joint of the steam packing ring, there is always an opportunity for the steam to have access under the ring if not placed right. Where possible to do so, it is best to locate the joint of the packing ring toward the bottom of the cylinder. The general tendency is for the piston to drag on the bottom of the cylinder, anyway, and if the joint of the ring be located there also, it acts as a seal to prevent steam getting under the ring. Pistons are usually at least $^1/_{32}$ in. smaller than the cylinder, and if the joint of the packing ring be located towards the top of the cylinder, it affords an opportunity for the steam to get under the ring and hold it tight against the cylinder walls. As the ends of the ring are more or less flexible, it is easy to see that the wear of this narrow strip of metal, usually quite hard, will wear away more metal than will the weight of the piston head with a much greater area, dragging on the bottom of the cylinder.

If time will permit, remove all of the reciprocating parts, and run a good sized silk or linen line through the cylinder and slide. By setting it to the counterbore of the cylinder, you can soon tell whether the cylinder has been erected out of line. If out any, make a note of it, or better yet, stamp it with figures on the flange of the cylinder, and when setting the boring bar, set it as much off center as it was found necessary to place the line to bring it true with the slide.

If you wish, after boring the barrel of the cylinder, you can also take a light cut over the counterbore, either wholly or in part so as to establish a new, accurate counterbore for future lining of bar or line.

Do not let your packing ring wear to a sharp edge, as this will cause greater wear than necessary. Take a smooth file and "break" the edges to about a 45-deg. angle all around. Do this also with the junk ring and follower. This will cause the piston to slide over the bore with the least friction, and will not scrape part of the cylinder oil off the cylinder walls, as a sharp edge will do. G. H. WALLACE.

Method of Measuring Length of Boiler

SINCE THERE is such a diversity of opinions as to the proper way to measure the length of a Stirling, B. & W. or Heine boiler drum, I am asking the readers of Practical Engineer if they know of a standard or accepted method. Some claim from center to center of the rivets in the head and end plates; others, from edge to edge of end plates measured beyond the rivets; while still others take the maximum inside measurement, including the bulge of the heads.

How is the length of a fire-tube boiler measured?

G. A. W.

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The Gain From Unaflow

Temperature of saturated steam is dependent on pressure, as is also the total amount of heat that a pound of steam contains. It follows that when pressure falls, temperature falls also, and if there is moisture in the steam, it tends to evaporate, partly.

During expansion, therefore, the pressure falling within the cylinder carries temperature down also, and moisture would be evaporated, but for the fact that heat is taken from the steam in doing work, and thus some of the steam is condensed. It has been proved by experiment that a film of moisture is thus produced on the cylinder walls, and the sweeping away of this film by the exhaust steam, as it is pushed out of the cylinder by the returning piston has a serious cooling effect on the walls, which must be heated up by incoming steam or by compression.

Any means of lessening the cooling of cylinder walls will lessen the steam condensed during admission, hence the steam consumption. What are the causes of cooling? First the drop in pressure and temperature during expansion; second, evaporation of the film of moisture, due to terminal drop; third, absorption of heat by currents of moist steam passing over the surfaces during exhaust.

The first cause cannot be removed. The second may be reduced by preventing the formation of the film, usually accomplished by jacketing heads and barrel with high-pressure steam. The third is the cause against which the unaflow design is directed, and the gains thus obtained are indisputable. Indeed, they are so large that they seem out of proportion to the mere flow of the steam past the dried walls of the barrel of the cylinder, and seem to call for other explanation.

This may possibly be found in 3 features that are embodied in practically all unaflow designs. The first is the poppet type of steam valve, which can be made practically absolutely tight, thus avoiding leakage loss which has been claimed by some investigators to be almost as large as condensation loss. The second is steam jackets on heads and a part of the barrel, which tends to remove the second cause of condensation. The third is high compression, which will warm up the cylinder surfaces before admission to a temperature near to that of the incoming steam.

It seems fair to assume that part of the steam saving is due to these 3 causes, and it would be interesting to know just how much is due to each, and how much to the unaflow action proper which is secured by the center exhaust.

Belting Cost and Life

IT HAS been called to our attention that the article on Power Transmission Economics, in the issue of Oct. 15, contained some statements liable to be misunderstood.

The figures for comparative cost are not given in dollars and cents, but as compared to the cost of a 2-in. single leather belt taken as unity. In the entire series no costs are given in money, since costs measured in this way would vary with the market price, and with freight; but all costs are compared to that of some standard piece of equipment in the installation, whose market cost can be easily ascertained, and from this the cost of any other part of the equipment figured. This should be carefully

noted by all readers, and the charts and examples used accordingly.

As to the life of belting, we are assured by makers and users of leather belting that it is not unusual for a leather belt to be in continuous service 35 to 40 yr., instead of the 6 to 8 yr. stated in the article referred to, and that even manufacturers of rubber and stitched canvas belts will hardly claim for their product as long a life as is given by any leather belt of reasonable quality. EDITORS.

Red Cross Christmas Seals

THIS is the season when the Red Cross Christmas Seal makes its appeal to the hearts of everyone, for a double reason: first, it expresses the spirit of the season, and second, it helps to fight one of the greatest enemies of humanity, and one which causes more suffering than almost any other, the "white plague" or tuberculosis. The sale opened on Nov. 30 throughout the country, and should receive the hearty co-operation of everyone. These seals and stamps serve the same purpose as any others, and the money expended for them all goes in the service of a good cause.

Belts and Belting

TIGHT VS. SLACK BELTS. BY N. G. NEAR

YOU have doubtless read article after article on belts —slack belts, tight belts, low-speed and high-speed belts, slipping belts, steel belts, and the relative economies of each and all; but have you ever taken any of the articles into consideration? Have you actually made use of the principles taught in a serious effort to better belt conditions, or have you merely "let 'em slide," the way the average human being is prone to do as long as the belts are running and the pulleys rotating, even though in a wasteful fashion?

If you are hard to convince—if you want to *prove* to your own satisfaction that tight belts are wasteful of energy, here is a little test that you should run.

Most modern high-speed engines are equipped with flywheels which have considerable energy stored up when in motion. Therefore, when the throttle valve or propelling energy is cut off it takes considerable time for the engine to come to rest, a fact with which every engineer is well acquainted. Some engines stop within a minute's time, some require 5 min. or more, and in the case of the steam turbine, the rotors of which run at very high speeds, 2 or more hours are required for the rotor to come to a dead stop.

I have timed engines, after abruptly cutting off the steam, and in every case the time required for any given machine to come to a stop is constant. Take a nonbelted motor, for instance, pulling no load; run it at normal speed for a minute or so; then cut it off. In several tests of this kind, take the time required for the motor to come to rest and you will find the time factor to be constant.

This fact can be made use of quite nicely in a multitude of friction tests, no matter what the material of which the rotating element is composed. All that is required is mass. The wires and core of a motor or dynamo possess mass as well as do flywheels and turbine rotors and the principle is therefore equally applicable.

I suggest that in this test, you run your engine and tightly belted dynamo at normal speed and no load for a minute or so, then quickly cut off the steam, and take the time required to come to rest. Try it again and learn for your own satisfaction that the time is a constant quantity.

Next, allow some slack in the belt and try it again. You will find that considerably more time is consumed in stopping and are therefore supplied with absolute proof that slack belts are best.

Now, being convinced, why not run your belts slack? Why run them tight? Instructions for running belts slack without slip have appeared galore and should not need to be printed again; but if anybody wants me to tell how to do it, again, I will gladly comply.

As for slip, have you ever stopped to think how expensive it is in actual dollars and cents? Do you know that if the main belt of an engine slips 1 per cent, 1 per cent of the engine's power is lost in slip-friction? If the slip is 2 per cent, 2 per cent of the engine's power is lost, 3 per cent slip, 3 per cent power, etc. The reason is plain; the belt becomes a 1, 2, or 3 per cent Prony brake. If the slip should become as high as 100 per cent, the belt would not move at all; at least the driven pulley would not move, resulting in a power loss of 100 per cent. The belt would then actually be a Prony brake.

Some men say, "Oh well, what's the use worrying about belts in this day? Belts are out of date anyway. Direct motor drive is the thing and belts will soon be put out of business."

Other factors are creeping in, ball bearings are supplanting plain bearings in line shafts as well as in machine bearings, speeds are being increased, and, as a result the cost of transmission machinery is being reduced with the efficiencies increased. Whereas, at the same time, the cost and efficiency of the direct motor drive are at a comparative standstill.

Better study belt transmission and efficiency a little and make that much desired improvement.

IN CUMBERLAND, MD., is now being completed by the Edison Electric Illuminating Co. one of the largest electrical power plants between Baltimore and Pittsburgh, representing an outlay of $500,000. Situated on the Potomac river, it will furnish power and light in Cumberland and vicinity.

The main building, which contains boiler and turbine rooms, is 138 by 34 ft., of brick with metal sash, and roof of concrete slabs, covered by Barrett roofing. The turbine room contains 2 2000 and 1 1000-kw. Curtis steam turbines, with exciters and controlling apparatus, all operating on condenser equipment supplied by the C. H. Wheeler Condenser Co., of Philadelphia, the condensing water being taken from the Potomac river. Switchboard and transformers are on a gallery in the turbine room, and the main turbine units have been brought to the level of the switchboard gallery, the condenser equipment being on the level of the main floor.

In the boiler room are 6 Heine water-tube boilers of 522 hp. each, with superheaters arranged for giving 150 deg. superheat, and fired by Taylor automatic stokers of capacity to permit forcing the boilers to 250 per cent rating under forced draft, although under ordinary conditions of operation, the natural draft supplied by the 225-ft. chimney, 11 ft. in diameter, will be sufficient.

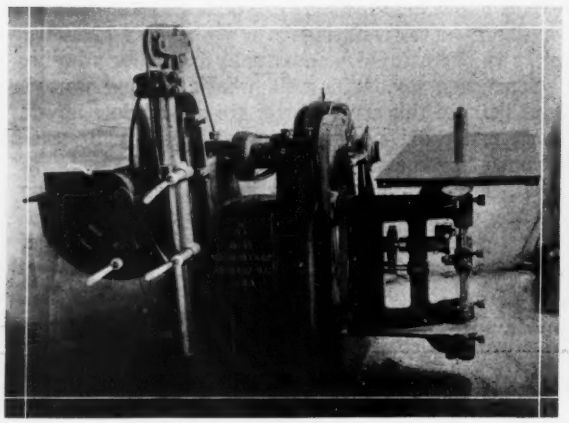
Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Disk Grinder and Drum Sander

THE illustration shows a motor-driven patternmakers' disk grinder, manufactured by Charles H. Besley & Co., Chicago, all gear guards being removed to show the construction.

The disk wheel is of steel, 30 in. diameter by ¾ in. thick, and runs at 750 r.p.m. The work table serving the disk wheel is 14 in. wide by 40 in. long, and may be tilted and locked at any angle from 75 to 135 deg. from the plane of the grinding disk, large, distinct graduations being provided to govern this angular adjustment. The work table has a vertical adjustment of 25 in., and being supported by a round vertical shaft, it may be swung away from the grinding disk for convenience in resetting the wheel or facing off extra large patterns.



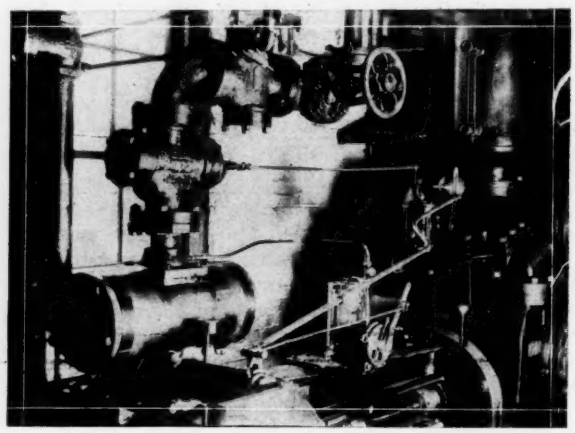
MOTOR-DRIVEN DISK GRINDER

The drive is furnished by a 3-hp. Westinghouse electric induction motor, 1140 r.p.m.

Novel Pump Governing

IN the plant of Sidney Blumenthal Co., at Shelton, Conn., is installed an unusual system of pump control which is interesting for its ingenuity as well as for the results accomplished. A steam pump speed governor, made by the Mason Regulator Co., of Boston, Mass., is mounted on a Davidson 18 by 16 by 24-in., double-acting pump, which forces water through 2 Roberts pressure filters in multiple into a tank approximately 20 ft. above ground level. These filters have a capacity of 1,000,000 gal. in 24 hr., and the object of the speed governor is to avoid forcing the filters in case of variable steam pressure.

In series with the balanced valve which is used with the speed governor, is another Mason balanced valve of the same type, which is operated by a float in the tank, to shut down or start the pump as the tank gets full or partially empty, making the filter plant practically automatic. When first installed, the speed governor gave some trouble, due to the float-operated valve which would open as the tank emptied, allowing the steam pressure to act on the piston of the pump, and causing the pump to race until the speed governor gathered sufficient oil pressure to take hold and govern. This was overcome by installing an adjustable bracket under the weight lever which holds it up practically in operating position and allows the pump to accelerate properly.



MASON GOVERNING FOR SPEED AND WATER LEVEL

The above description and accompanying photograph, submitted by H. N. Downs, operating engineer at the Blumenthal Co.'s plant, received first prize in the photographic contest of the Mason Regulator Co. The second prize installation will be described in the Dec. 15 issue.

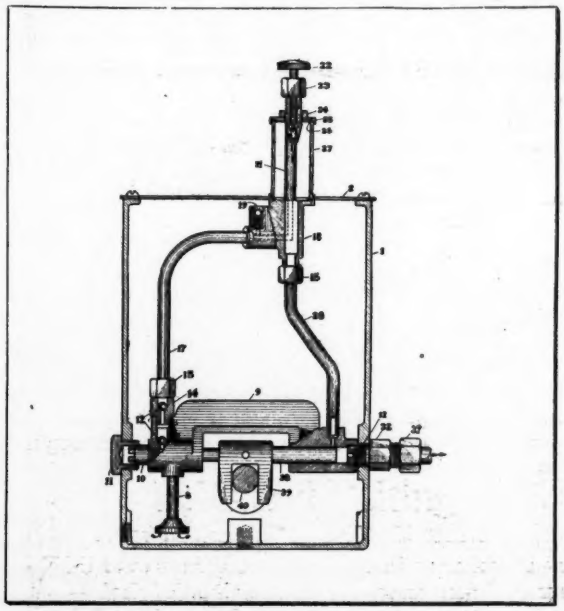
Neat and Efficient Lubricator

ONE of the neatest and most efficient force feed lubricators on the market is that manufactured by the Krahn Manufacturing Co., of Milwaukee, Wis.

The manufacturers of this lubricator claim that it is exceedingly strong and simple in construction, that it is impossible for it to get out of order, and that the drive is positive as there are no belts or frictions to slip. They are made with ratchet or direct drive, the latter having the driving lever reciprocate through an angle of 76 deg. The construction of the pump is such

that a clear vision of the feeds can be had from a great distance or any position, a feature which every engineer will readily appreciate.

In the accompanying illustration is shown a sectional view of this lubricator. The operation of the pump is as follows:



KRAHN FORCE FEED LUBRICATOR

The level is given a reciprocating motion from an external source; as the valve gear of an engine. On the ratchet pump, the lever causes the shaft to revolve in one direction giving a reciprocating motion to the plunger through the crosshead. On the direct drive, the pump shaft does not revolve but oscillates so as to give the plunger the required stroke.

The oil is drawn by the stroke of the plunger through the inlet pipe (8) into the cylinder (9). On the return stroke, the oil is forced up the inlet pipe (17) past the bypass (19) into the regulating valve (21) from where it drops from the drip nozzle through the sight feed and outlet pipe into the cylinder and is forced out into the feed line past the check valve by the plunger on the next stroke.

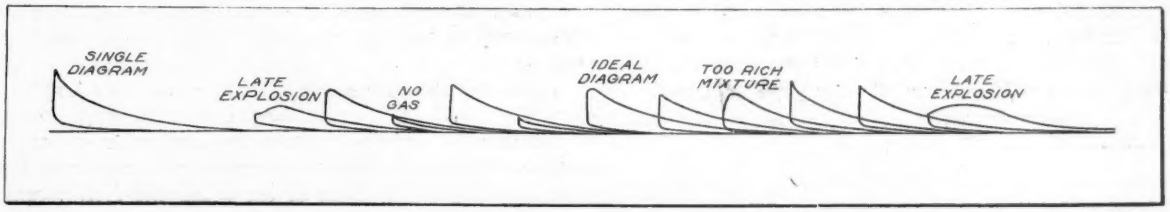
TO PRODUCE extreme hardness in steel, heat slightly, then immerse in a mixture of 4 parts water, 2 parts salt and 1 part flour, till it is thoroughly coated. Then heat the metal to a cherry red and plunge in soft water.—Machinery.

Gas Engine Adjusting

THE illustration herewith shows a continuous diagram taken with a Trill continuous card indicator from a gas engine cylinder, while adjustments were being made, to get the proper action of the engine. The single diagram is a reproduction of the third from the left-hand end, and shows practically ideal performance, with possibly the explosion a trifle early. The first of the series shows a late explosion due to wrong setting of the timer; before the next explosion this was set forward, then there was a cycle where the hit and miss governor prevented the taking of gas, then another almost perfect cycle, another miss, then what is labeled the ideal diagram, although we would feel that slightly earlier ignition, with a sharper point at the top of the card, would probably denote better economy. A little later is a card where the carburetor has been changed so that the mixture is too rich, and while the ignition is early enough, the burning of the mixture is delayed by lack of sufficient air. The next 2 cards are very satisfactory, and then is shown one where the ignition is much too late, so that the explosion does not force the pressure up to its highest possible value.

It is easy to see that such a record as this during the adjustment of the action of the gas engine, is particularly valuable, as it enables the immediate study of the effect of different changes.

U. S. CIVIL SERVICE COMMISSION announces an examination for assistant engineer in forest products, on Dec. 2 and 3, 1914, to fill vacancies in the Forest Service for duty at Madison, Wis., and elsewhere as they may occur, at salaries ranging from $900 to $1200 a year. The following subjects will have the relative weights indicated: Technic of drying, treating, and testing timber, 25; mechanics and mathematics, 25; drafting, and machine and structural design, 25; education, training, and experience, 25. An educational training equivalent to that required for a bachelor's degree in mechanical or civil engineering from a reputable college or university or the fact that applicants are senior students and are pursuing studies which will entitle them to such a degree or practical work in design and construction equivalent to such training, is a prerequisite for consideration for this position. Applicants must have reached their twentieth but not their fortieth birthday on the date of the examination. Each applicant will be required to submit to the examiner on the day of the examination an unmounted photograph of himself taken within 2 yr. In applying for this examination, ask for Form 1312, using the title, Assistant Engineer in Forest Products (Male).



GAS ENGINE DIAGRAM TAKEN WITH TRILL CONTINUOUS CARD INDICATOR

News Notes

A REPORT has recently been circulated to the effect that the International Engineering Congress was to be abandoned. This is not correct; the Congress will be held in San Francisco as scheduled, from Sept. 20 to 25, 1915.

In view of the conditions now prevailing in Europe, the governing bodies of the 5 National Societies under whose auspices the Congress is to be held, have recently given careful consideration to the feasibility of holding the Congress and to the probability of its success, with the result that each body has unanimously confirmed its original pledge to support the Congress.

The Committee of Management is in receipt of a sufficient number of communications from various foreign countries throughout the world, including those located within the war zone, to indicate that a large majority of the papers originally requested for presentation at the sessions of the Congress and publication in its transactions will be handed in on time, and that the Congress will be truly international in character.

A detailed circular of information regarding the publications of the Congress has been prepared by the Committee and will be sent upon application to the Secretary, in the Foxcroft Bldg., San Francisco, Calif.

THE CITY OF Ponta Delgada, St. Michael's, Azores, will consider bids of American firms for the installation in whole or part of an electric lighting plant for illuminating the city streets. Specifications have not been completed, but may be obtained from the president of the Camara Municipal, Ponta Delgada, St. Michael's, Azores.

Tentative plans contemplated the use of steam power for generating electricity. A small plant which now provides power for lighting a few streets is worked by water power.

The city is one of 20,000 inhabitants, with many streets. Bids will be asked for all parts of an electric lighting plant, electric lights for the streets, wiring, and all machinery necessary for the installation.

Manufacturers desiring to submit bids for the plan or electric supplies should write at once to the president of the Camara Municipal, addressing him in Portuguese, if possible. It is probable that all details will be ready for distribution about Dec. 1.

U. S. CIVIL SERVICE COMMISSION announces an examination, on Dec. 8, 1914, for mechanical engineer assistant for experimental work in marine engineering, to fill a vacancy in the Engineering Experiment Station, United States Naval Academy, Navy Department, Annapolis, Md., at $8 a day. Duties will be to conduct tests on appliances constructed for use on vessels of the Navy, and to make adequate reports of such tests. and to prosecute research work that will be helpful to the designing division of the Bureau of Steam Engineering, Navy Dept., Washington, D. C.

The following subjects will have the relative weights indicated: General education and technical training, 30; professional experience and fitness, 40; publications or reports, 30. Graduation with a bachelor's degree in mechanical or marine engineering, and at least 3 yr. subsequent experience with marine machinery and equipment, are prerequisites for consideration for this position. Under subject 3, the applicant must have demonstrated a capacity for preparing reports as shown in manuscript reports or published papers. Applicants must have reached their twenty-fifth but not their fortieth birthday on the date of the examination. Apply for Forms 304 and 2095, giving the title, Mechanical Engineer Assistant (Male).

DECEMBER 9 TO 12, the meeting of the National Society for Promotion of Industrial Education will be held at Richmond, Va., headquarters being in the Hotel Jefferson. The chief topic for discussion will be the Survey of the Industries in Richmond, which has recently been completed, and the findings of those who have made this survey, to determine what should be the proper vocational teaching in its schools. Industrial and vocational training are one of the most important problems before our country at the present time, and deserve careful attention on the part of everyone interested in the country's welfare. This meeting of the society will undoubtedly be of great importance, and it is to be hoped that, as a result, the movement may be carried forward largely.

AT MAXVILLE, MONT., machinery for the Granite County Power Co. is now being installed by Walter Neal, who is in charge of erection. It is expected that the plant will be completed by the first of the year, and will then generate current at 6600 v., to be transmitted 6 mi. to the property of the Royal Basin Mining & Milling Co., where it will be used in driving grinding machinery and to furnish light and power for several small towns nearby. Possibly the line may be extended to Drummond. The transmission line is carried on timber poles cut from the property, through the heavily timbered region, and at the substation is stepped down to 440 v. for use on motors. Building equipment was furnished by the Allis-Chalmers Co., Milwaukee, Wis.

THE CHAMBERLIN CO., of Detroit, Mich., which makes a specialty of sales and advertising campaigns for manufacturers of machinery, has changed its offices to 1201-3 Kreske Bldg., and C. W. Brooke, who has had long experience in this line of work, becomes secretary and treasurer of the company.

ANNOUNCEMENT IS MADE by the Northern Equipment Co., of Erie, Pa., that J. H. Dougherty, formerly of the Engineering Department of the Jeansville Iron Works, of Hazelton, Pa., has recently joined its staff as designing engineer.

U. S. CIVIL SERVICE COMMISSION announces an examination, Dec. 15, 1914, for hydro-electrical engineer to fill a vacancy in the Quartermaster Corps of the Army, War Dept., for service at Camp John Hay, Philippine Islands. The salary is $2400 a yr., and in addition transportation and expenses will be furnished. Return transportation and expenses will also be furnished provided the employe remain for 3 yr. or more. The following subjects will have the relative weights indicated: General education and technical training, 40; practical experience and fitness, 60. A knowledge of the laws of

electricity and magnetism, and a practical knowledge of the design, construction, and testing of dynamos, motors and auxiliary electrical apparatus, hydraulic turbines, impulse wheels and mechanical auxiliaries of a hydro-electric power plant, is a prerequisite for consideration. Applicants must have had at least 6 yr. experience of which 2 must have been in the constructing and installing of electric and hydro-electric machinery, and 4 in mechanical and electrical engineering. Graduation from a technical school of recognized standing will be accepted as equivalent to 1 yr. of the required practical experience. Applicants must have reached their 25th but not their 45th birthday. Apply for Form 304, and special form, giving the title, Hydro-Electrical Engineer (Male).

Catalog Notes

TEXTILE QUARTERLY No. 8, issued by the Westinghouse Electric & Mfg. Co., consists of a reprint of a paper by A. E. Rickards, General Manager of the Industrial Engineering Co., Pittsburgh, Pa., in the Electric Journal on the Situation Before the Cotton Textile Manufacturers. The paper is a thorough discussion and analysis of the cotton textile industry with regard to expense of operation and the profits to be derived therefrom. A number of tables are given as well as curves showing the proportion of different kinds of power used to drive these mills. The booklet is also well illustrated with a number of textile installations.

"KEWANEE" UNIONS, combination brass and iron ground ball joint, male and female pattern, are described, and their advantages are enumerated in the latest circular of National Tube Co., Pittsburgh, Pa.

The company will be pleased to forward a copy of the circular to any reader at his request.

KITTS STEAM SPECIALTY CO., of East 1st St., Oswego, N. Y., has issued a circular giving advantages and explaining the operation of its O-K steam trap.

Another recent circular from the same company relates to the W. A. Kitts O-K reducing valve.

THE STORY of a Tool Maker, reprinted from The Caxton, a magazine for business men, relates some experiences and methods of the head of the L. S. Starrett Co., Athol, Mass.

SMOOTH-ON CEMENT No. 7 for Concrete Construction is the subject of a folder from Smooth-On Mfg. Co., Jersey City, N. J.

FROM THE GOODYEAR Tire & Rubber Co., of Akron, Ohio, we have received an interesting set of booklets and catalogs dealing with the various applications of its products.

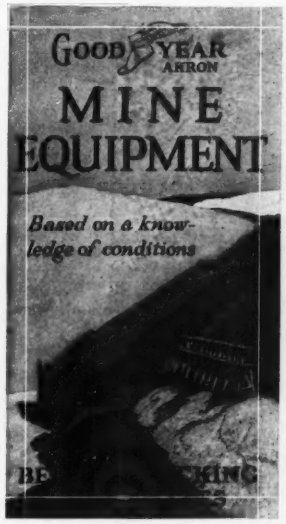
The general catalog, which is entitled "Goodyear Mechanical Rubber Goods," deals with the complete line of Balata, rubber and rubber-covered canvas belting, all types of hose, including the Kantkink flexible metallic, and special designs for acids, air, hot water and vacuum, the sheet and rod packings of different brands, rubber tiling and mats, and special rubber shapes. This book contains over 100 pages of descriptions, data and information, and gives a good general idea of all the products of the company.

In addition to this, there are special booklets treating on the use of various products for different fields. "Goodyear Mine Equipment" tells of the special belting, packing, hose and valve packings which would naturally be used in mines for transmission, for bucket and belt conveyors, for air drill supply, steam, suction and water lines, and for engines and pumps. It is an interesting little book, whose attractive cover is shown in the cut herewith.

A further discussion of the Kantkink flexible hose is given in the booklet entitled "Prevent The Kink," which shows the different places where this improved form will be of particular value and convenience.

Also, for carrying steam, a booklet entitled "Better Steam Hose" explains the use of the Kantkink hose for this purpose, and shows other brands specially made for steam lines, but without the metallic casing feature.

The particular adaptability of the Goodyear brands of belting for the difficult service found in paper mills



is emphasized in the "Goodyear Paper Mill Book," which tells of the needs for drives with long centers, main drives, use on small pulleys and where there is much moisture. It also treats briefly of other materials used in the paper mill, such as hose, packing and pump valves.

For grain elevators, a special booklet explains the qualities of the company's product for bucket elevator belts, for belt conveyors, and the features of the Goodyear fire hose; while a special booklet on flat conveyor belts describes the different brands specially made for this purpose.

"Balata Belting," the title given to 2 booklets, covers the qualities of this increasingly popular material, showing its comparative strength, the power that it will transmit, the advantages of continuous belting of any length, and giving directions for the care of Balata belting, and suggestions as to figuring the size of belt required for any drive. A smaller book is a somewhat briefer treatment on the same subject.

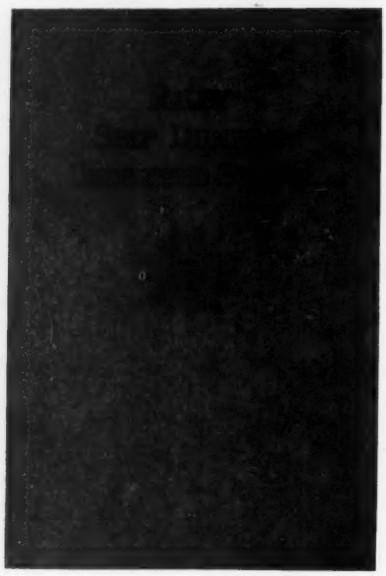
In this field of belting, the booklet on "Goodyear Sawmill Belting" deals with the same brands but shows their particular adaptation for main drives, log hauls,

edgers, trimmers, planing machinery, and the other difficult high speed drives found in re-saws, joiners, etc.

For those who have to struggle with the support of automobiles, the book on "Fundamentals of Tire Construction" is particularly interesting, as it shows the process of preparing the rubber, the qualities secured by admixture of various ingredients, and then tells the complete process, with illustrations showing the actual work being done, for the manufacture of different types of casings and tubes. It shows what construction is adapted for the various parts, and how this is worked out in the Goodyear factory.

A MOST ATTRACTIVE introduction to the Riley Self-dumping Underfeed Stoker is given by a new catalog just received, and the cover of which is illustrated herewith.

The first favorable impression is increased by reading and studying the pages inside the cover, which show in full detail the construction and method of operation



of the stoker, just how each part works, why it is made of certain form, and how the entire running of the stoker is conducted. An interesting feature is the illustrations of installations in many large lighting plants and power stations throughout the country. The catalog is issued by the Sanford Riley Stoker Co., Worcester, Mass.

VARIOUS TYPES of pumps made by American Steam Pump Co., Battle Creek, Mich., are illustrated in Form 354, recently received.

A FOLDER whose illustrations give a brief visualized answer to the question how to take charge of a client's publicity, was lately received from Walter B. Snow, 136 Federal St., Boston, Mass.

FROM RELIANCE POWER SPECIALTY Co., 1041 Marquette Bldg., Chicago, comes a circular relating to the Reliance adjustable self-feeding tube expander, designed for use in any type of water-tube boiler.

"SIROCCO" AT THE Ford plant is discussed in a pamphlet which is being sent out by American Blower Co., Detroit, Mich. Illustrations show the handling of air distribution in the main American plant of the Ford Motor Co., at Detroit, in which is installed the "Sirocco" heating, ventilating and cooling system.

THE HOWARD ball valve, made of bronze and guaranteed for 300 lb. working pressure, is described and illustrated in a folder from Howard Iron Works, Buffalo, N. Y.

ENGINEERING DEPARTMENT of National Lamp Works of General Electric Co., Cleveland, O., recently issued Bulletin 21, on The Successful Handling of the Small Consumer in Europe, by S. E. Doane, reprinted from the proceedings of the National Electric Light Association.

HELPING THE WOODWORKER is the title of an attractive pamphlet just issued by the Westinghouse Electric & Mfg. Co., giving in conversational form arguments for the use of motor drive for wood-working plants. During the conversation of the manager of a wood-working plant and a Westinghouse salesman, many points are brought out which are of interest to the operator of a wood-working plant.

FOXBORO THERMOMETERS and Thermographs, Bulletin No. 91, was lately issued by the Industrial Instrument Co., Foxboro, Mass. This bulletin illustrates several types of thermometers, thermographs and other apparatus. Specimen charts from Foxboro long distance thermometers installed on feed water heaters, etc., and from 8, 10 and 12-in. long distance thermographs are also given.

THE GENERAL ELECTRIC CO. has just issued a bulletin, No. 48,015, illustrating and describing its Type M transformer for operating electric stop-motion of textile machinery. This transformer is for use in connection with the operation of textile machinery such as drawing frames, combers, warpers, etc., the operation of which may be materially improved by a dependable source of electric energy for the stop-motion magnets.

NATIONAL TUBE CO., of Pittsburgh, Pa., has had taken a series of films for motion pictures, showing the manufacture of NATIONAL pipe from iron ore to finished product. These start with the excavating of the ore in the Messaba Ranges, and follow, step by step, through the shipment, the furnaces for making pig iron, the refining process for making the steel, working the metal, and finally the manufacture of pipe in large and small sizes at the Company's plant in McKeesport, Pa. These films are now being shown in the middle eastern states, and information as to the time and place of exhibit may be obtained from the National Tube Co.'s offices, 30 Church St., New York City.

"POWER PLANT PLANS from Actual Practice of the Murray Iron Works, of Burlington, Iowa," is the title of Pamphlet 12, issued by that company, and contains 60 plans of power plants, which are reproductions of actual plans used by the company in making installations. It shows the arrangement of boilers and engines, piping arrangement and sizes used, list of pipe required, the sizes of stacks and breechings, and, in many cases, arrangement of belt and rope transmissions.

It is a valuable book for any one who has the problem of designing or rearranging a plant, or who wishes

to make a study of the proper ways of laying out plants, as the plans shown are of installations actually made. The pages are 8½ by 11½ in., so that the drawings and dimensions are large enough to be easily read.

BULLETIN NO. 42,800, recently issued by the General Electric Co. contains a reprint of an article appearing in the General Electric Review, devoted to the use of electrically driven air compressors in foundries. This bulletin compares centrifugal compressors with the ordinary fan blower and the positive pressure blower, and shows the superiority of the centrifugal compressor for this class of service.

RAILWAY DATA Exchange No. 10, issued by the Westinghouse Electric & Mfg. Co., contains a considerable amount of data pertaining to the operation of street railways, dealing more particularly with the following subjects: improvement of voltage on interurban lines, effects of voltage on performance of motors, cost of stops and trailer operation, saving energy, train operation in city and interurban service, as well as a number of other equally important subjects in the treatment of which considerable valuable data is given.

Heavy Traffic Centers, Circular 1549, shows a large number of handsome engravings illustrating the conditions in various large cities throughout the country where surface lines are equipped with Westinghouse apparatus.

1500-volt Direct-Current Substation Equipments, No. 1550, deals with the class of apparatus its title indicates, descriptions of a number of different roads throughout the country which are using this type of equipment being given, and a number of these profusely illustrated. Maps are also given of these properties showing the territory covered, and considerable operating data is included. Switchboards and accessories for use on 1500-volt direct-current lines are illustrated and described.

Trade Notes

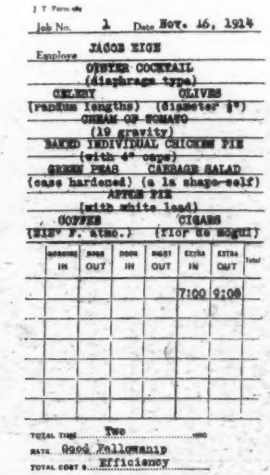
GOODYEAR TIRE & RUBBER CO., of Akron, O., at the close of its first year of experience with the "Safety First" movement in its factory, has issued a comprehensive report on the results. The company has employed an engineer whose business it is to install safeguards for machinery and safety precautions for operatives, and there is also a Central Committee which reports daily to its chairman, the assistant to the factory manager, on dangerous conditions found in the plant. This Central Committee has 9 members, each one being chairman of a Division Inspection Committee, so that the total membership of these committees is 307, thus giving a careful supervision over all of the 7500 workmen in regard to safety precautions.

Besides the "Safety First" work, the Goodyear Co. carries out a line of welfare work, a school for foremen on organization and management, giving 2 lessons a week for 6 months, a library, labor department, hospital service and lunch room for employes.

AS A RESULT of a 60-day trial of 2 1½-in. Simplex valves, which were bought by the Champion Fibre Co., of Canton, N. C., Oct. 27, 1913, the Yarnall-Waring Co., which makes the Simplex valves, received an order on Aug. 18, 1914, for 20 of the same size, followed on Oct. 20 by an order for 24, and on Nov. 9 another order for 15, making a total of 61 of these valves purchased within 13 months by the Champion Fibre Co.

IN THE FALL of 1913, the Mountain Ice Co. installed a turbo-generator plant to furnish power and light for its ice harvesting and storage plant at Lake Hopatacong, N. J. This 375-kv.a. Terry turbo-alternator set gave excellent service last winter, and has resulted in the installation of a 219-kv.a. set in the company's plant at Gouldsboro, Pa. Also the Excelsior Needle Co., of Torrington, Conn., is installing a 375-kv.a. set in its power plant.

ON THE 16th of November, Fisher Governor Co., Marshalltown, Iowa, entertained its entire shop and office force at a dinner and theater party to celebrate the fact that business done in October, both as to volume and


Job No. 1 Date Nov. 16, 1914
Employe JACOB HIGH
OYSTER COCKTAIL
(diaphragm type)
CELERY OLIVES
(radius lengths) (diameter ¾")
CREAM OF TOMATO
(19 gravity)
BAKED INDIVIDUAL CHICKEN PIE
(with 4" cups)
GREEN PEAS CABBAGE SALAD
(case hardened) (a la shape-self)
APPLE PIE
(with white lead)
COFFEE CIGARS
(Riv. F. Aug.) (Flor de Night)

MORNING IN	MORN OUT	NOON IN	NOON OUT	EXTRA IN	EXTRA OUT	Total
				7:00	9:00	

TOTAL TIME Two HRS.
RATE 0906 Fellowship
TOTAL COST $ Efficiency

value, was the largest of any month in the history of the company. Novel place cards, as shown herewith, were used, each being filled out in the regular method of a time ticket. That such a celebration should be held for such a reason is a gratifying indication of the improvement of conditions and a promise of future prosperity.

THE LACLEDE-CHRISTY Clay Products Co. has received an order from the Anheuser-Busch Brewing Assn., of St. Louis, for a 772-hp. "Laclede-Christy" chain grate stoker. The notable feature of this installation is the large size of the stoker. The furnace width is 15 ft. and the length of the stoker 11 ft. 6 in. This is the eleventh "Laclede-Christy" chain grate stoker that the Anheuser-Busch Brewing Assn. has installed in its Second St. ice plant. It is reported that this plant is the largest ice plant under one roof in the United States.

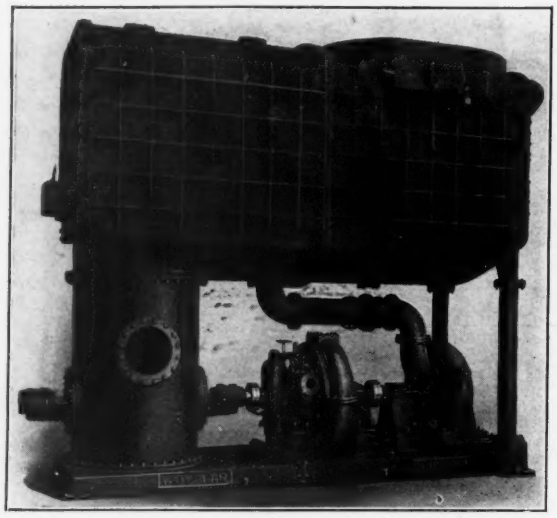
IN THE CHAMPION oil burner, invented by W. M. Surface, and manufactured by the Champion Oil Burner Co., of Kingman, Kans., the oil supply comes from below into a middle pipe, steam coming into that same pipe from above and mixing with the oil, and this mixture then passes into the burner head, which is a round compartment with a horizontal outlet slot. Just before the mixture leaves the head, it comes in contact with 2 streams of live steam from the 2 side pipes, which are controlled by separate valves, thus thoroughly atomizing the mixture as it enters the blaze.

In addition to the atomizing effect, these side pipes give control of the blaze, as the amount of steam intro-

duced in this way regulates the width of the flame. When the pipes are closed, the blaze will shoot straight back, but by opening the valves, the width of the blaze may be made as desired to fit the furnace conditions.

The burner works in connection with a pump and pressure tank, and may easily be installed to fit any furnace.

A WHEELER rectangular rain-type counter-current jet condenser of latest design, with complete turbine-driven, self-contained auxiliaries is shown by the illustration. This condenser was supplied to the City of Seattle by the Wheeler Condenser & Engineering Co., Carteret, N. J., and has a capacity of 97,500 lb. of steam per hour at 28½ in. vacuum. The photograph is taken



looking into the discharge of the tail pump, which is of the submerged type and high speed design of direct drive by the turbine. The Wheeler Turbo air pump is shown to the extreme right and, in the center, the turbine which drives both air pump and tail pump. This arrangement makes a compact and simple unit. The entire condenser and auxiliaries fit directly beneath the turbine.

THE BOSTON ELEVATED RAILWAY Co. has placed an order with the Westinghouse Electric & Mfg. Co. for 2 quadruple equipments of No. 306 motors, and type HL unit switch control for use on 2 new snow plows which are being built by this company and will be ready for the winter season.

Snow plow service, as is well known, is one of the hardest applications that has to be met by street railway equipments and the Boston Elevated Co. is taking particular pains to see that these cars and their equipment are such as will fully meet the service which they are designed to perform.

HEREAFTER, the Edward Mfg. Co. will be known as the Edward Valve and Mfg. Co. As the present plant in Chicago has become inadequate, plans are under way for a larger new plant in East Chicago, Ind., and as charter cannot be obtained in Indiana under the old name, because of the similarity to names of firms already incorporated in that state, the change to the new name was necessary.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

SEMI-MONTHLY

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH.

Subscription price in advance in the United States, Mexico or united possessions, $1.00 a year.

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Address all letters and make all checks and money orders payable to Technical Publishing Co., 537 So. Dearborn St., Chicago, Ill.

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Full page, one year, each insertion, $60.00.

Half page, one year, each insertion, $35.00.

Quarter page, one year, each insertion, $20.00.

Eighth page, one year, each insertion, $12.00.

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Other specified positions, regular rate plus 10 to 50 per cent.

Stippled plates used, but no heavy, black and white plates.

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Per line, 30 cents each insertion.

Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,500.

Technical Publishing Co.
537 S. Dearborn Street
Chicago

Position Wanted

POSITION WANTED—By young man, 19 years old, as fireman or assistant engineer. Experience with steam, electrical and refrigeration machinery. Can start Jan. 1st. References. Clarence Pickett, Pultneyville, N. Y. 11-1-1

POSITION WANTED—As Manager or Superintendent of a steam plant of 600 kv.a. capacity or less, where efficiency and net earnings is the slogan. Twenty-one years' experience. A1 references. Will be released about Nov. 1st. Address Box 373, Practical Engineer, Chicago, Ill. 11-1-1

POSITION WANTED—As chief engineer and electrician; 25 years' experience with steam and electrical equipments, and "Diesel Engines," accustomed to the economical management of power plants and their maintenance; erecting engineering experience; good all round mechanic and electrician; age 44, married, strictly sober; best of reference; correspondence solicited. Address Leonard Miller, 100 Greenleaf St., Brownwood, Texas. 11-15-1

POSITION WANTED—As Chief Engineer of steam or hydro-electric power plant of 1000 hp. or less. 15 years' experience in central station operation; strictly temperate; best of reference as to character and ability. Middle West preferred. Address Box 376, Practical Engineer. 12-1-1

POSITION WANTED—As Engineer. Can furnish best of reference. H. M. Risser, 2216 N. Tripp Ave., Chicago, Ill. 12-1-1

Wanted

AN OPPORTUNITY for High Class Salesmen. A well known, established concern, manufacturing power plant specialties, wants representatives in the following territories: Syracuse, N. Y.; Louisville, Ky.; Tacoma, Wash.; Birmingham, Ala.; Raleigh, N. C.; Nashville, Tenn.; Duluth, Minn.; Cincinnati, O.; Denver, Colo. Applicants must be able to show good selling record and possess a knowledge of boiler equipment. Excellent opportunity for high class men. Details of experience and references in first letter. Box 375, Practical Engineer, Chicago, Ill. tf.

FREE ENGINEERING BOOKS and power plant tools and specialties for securing new subscribers to Practical Engineer. A dandy chance for the engineer with a little spare time, to get some fine premiums. Send for free descriptive circular and terms. Address Practical Engineer, Subscription Department, Chicago, Ill. tf.

WANTED—Resident subscription agents in all cities of 50,000 population, and over. Many of the largest cities still open. An excellent chance for hustlers to turn their spare time into dollars. Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

WANTED—Engineers who have trouble with poor circulation, foaming or priming boilers and accumulation of scale and sediment and leaky tubes to know of our sure remedy for these evils. Write for details to Olson Automatic Boiler Circulator Co., 217 Chamber of Commerce Bldg., Chicago, Ill. 10-1-6

WANTED—A few hustlers to take orders for Zinco Soot Destroyer. Quick sale. No competition. Good proposition. New York Supply Exchange, Ford Bldg., Detroit, Mich. tf.

WANTED—ALL STEAM USERS to have clean boilers without using compounds or chemicals in any form. Write "Otis," No. 317 Norfolk Ave., Buffalo, N. Y. tf.

WANTED—Partner with $10,000 to invest in an established machinery business with or without services. References Bradstreets, Duns and our Bankers. Address Box 377, Practical Engineer, Chicago, Ill. 12-1-2

Help Wanted

AGENTS WANTED for the only gauge glass reflector that will absolutely show water level at all times. Reordway Mfg. & Sales Co., Marquette Bldg., Chicago. 12-1-1

WANTED—Agents on commission to sell our Shaking Grates. We will install grates on trial or put in on test at our expense with any grate made. Address Armstrong Mfg. Company, Springfield, Ohio. tf.

For Sale

GROBET SWISS FILES are the standard of excellence in files, and have been for over 100 years. We send post paid, as an introducer, 48 files especially adapted for tool makers and machinists on receipt of $5.00. This is a chance to get a set of files you'll appreciate and we'll get future orders. Montgomery & Co., 101 Fulton St., New York, N. Y. 12-1-1

FOR SALE—24x36-in., 100 revolutions, 125-lb. automatic cutoff Conway engine, right hand, shaft 18 ft. 6 in. long with two wheels 12 ft. 2 in. by 26-in. face and 11 ft. 10 in. by 20-in. face. In good condition and can be seen running any time before Nov. 1st. Built by Filer & Stowell Co., Milwaukee. Is as economical as a Corliss. Worcester Lumber Co., Ltd., Chassell, Mich. 11-1-4

FOR QUICK SALE—One 12x36 Atlas Corliss over-runner engine and one Atlas boiler, 14x5 with 3½-in. flues; both engine and boiler are in fine shape, and we will sell them cheap if sold at once, as we are changing our power from steam to electric. The Bloomington Milling Co., Bloomington, Ind. 11-15-2

CORLISS ENGINES: 10x24 Allis, $375; 17x24 Erie City, 4 valve, 675; 16x36 Fishkill, $500; 18x30 Allis, $700; 18x42 Allis, $750; 18x36 Fraser & Chalmers, $550; 20x42 Vilter, $600; 28x48 Hamilton, $1000. Duzets & Son, Hudson Terminal, New York. tf.

FOR SALE—Gebhardt Steam Flow Meter, new, with following sized pitot tubes: 2, 2½, 3, 4, 5, 6, 8 and 12 in. Cost $135. Will take $120. P. A. Johnson, Springfield, Ore. 12-1-1

FOR SALE—12x30 Cooper Corliss engine. Nappanee Lumber & Mfg. Co., Nappanee, Ind. 11-15-2

Patents and Patent Attorneys

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Bldg., Washington, D. C. tf.

PATENTS THAT PROTECT AND PAY. Advice and books free. Highest references. Best results. Promptness assured. Send sketch or model for free search. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had, and the exact costs. Send for full information. tf.

PATENTS—Send sketch for free search and report. Books on patents and book of reference letters sent free. John S. Duffie & Co., 612 F St., Washington, D. C. tf.

"PATENT YOUR INVENTIONS."—Search free when patent applied for. Charles F. Kincheloe, Patent Lawyer, Woodward Building, Washington, D. C. 10-15-6

PATENTABLE IDEAS WANTED—Send for three free books. R. B. Owens, 28 Owen Bldg., Washington, D. C. tf.

Technical Books

ENGINEERS AND FIREMEN—Send 10c in stamps for a 40-page pamphlet containing a list of questions asked by an examining board of engineers. Stromberg Publishing Co., 2238 Pope Ave., St. Louis, Mo. 10-1-6

Educational and Instruction

ENGINEERS' POCKET MANUAL, 175 pages, edited by University of Tennessee, will be mailed every subscriber sending in NEW subscription (not your own) to Practical Engineer. Gilt edges; bound in leather.

Miscellaneous

IMPORTANT TO CONSUMERS of Boiler Compounds. Cost to consumers in the United States and Canada for Boiler Compound amounts annually to several million dollars. A thorough expert Boiler Chemist is open to negotiate with reputable firms who are seeking economy in this particular. Replies should be as complete as possible in matters of detail. All correspondence will be considered strictly confidential. Address "Expert," care Practical Engineer, 537 So. Dearborn St., Chicago, Ill. 12-1-4

ENGINEERS DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill. tf.

Sparks From The Advertising Pages

Among the reasons why you should read the Advertising Pages of Practical Engineer is one which bears directly on your salary, your future, your power plant and your firm. You should read them for the sake of *operating economy*.

The principal contribution to *operating economy* is plant equipment. When this plant equipment is modern and adapted to the conditions of service it gives the engineer *good material* to which he can apply his ideas for obtaining operating economy.

When it is *antiquated*, however, or when any part is not *exactly suited* to the service, the engineer must use too much of his *energy* and *ideas* to overcome *flaws*. His position might be likened to the farmer of river lands, where dirt embankments are thrown up to keep out flood water. This farmer must take work away from his crops and give it to the reinforcing of his levees during high waters—while the farmers along another river pay no attention to high water because their levees are correctly made of reinforced concrete.

And, Mr. Engineer, it matters little how good a workman you may be, you must have suitable tools and materials before you can turn out an excellent product. Your product is represented in the reduction of operating expense without lowering plant efficiency. Or in the increase of plant efficiency without adding to the plant expense.

So see that you get the most modern machines and tools—*equipment*. Read the advertising pages of Practical Engineer. They describe power plant equipment; tell the facts about it. All of this equipment is good, but some of it is best suited for your plant. And the installation of this equipment (it may be a simple appliance), in your plant, may give you lower operating cost than days of work and nights of planning.

Therefore, Mr. Engineer, when you go through your plant today, critically examine each piece of apparatus. Then, take home with you this issue of Practical Engineer, and in the home atmosphere spend your recreation moments by reading carefully through the advertising pages.

The time thus spent will be conducive to an increase in your knowledge of modern equipment, and more than likely it will put you in touch with an apparatus which will take a lot of time and trouble off your hands.